THE BULLETIN

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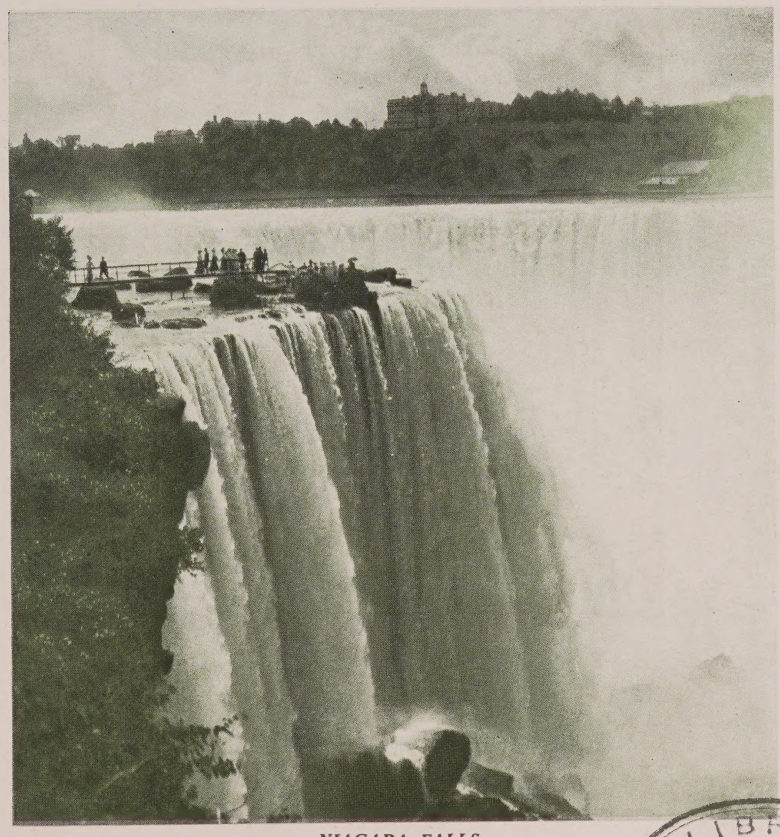
Hydro-Electric Power Commission of Ontario

JULY 1918



NIAGARA FALLS

THE
BULLETIN

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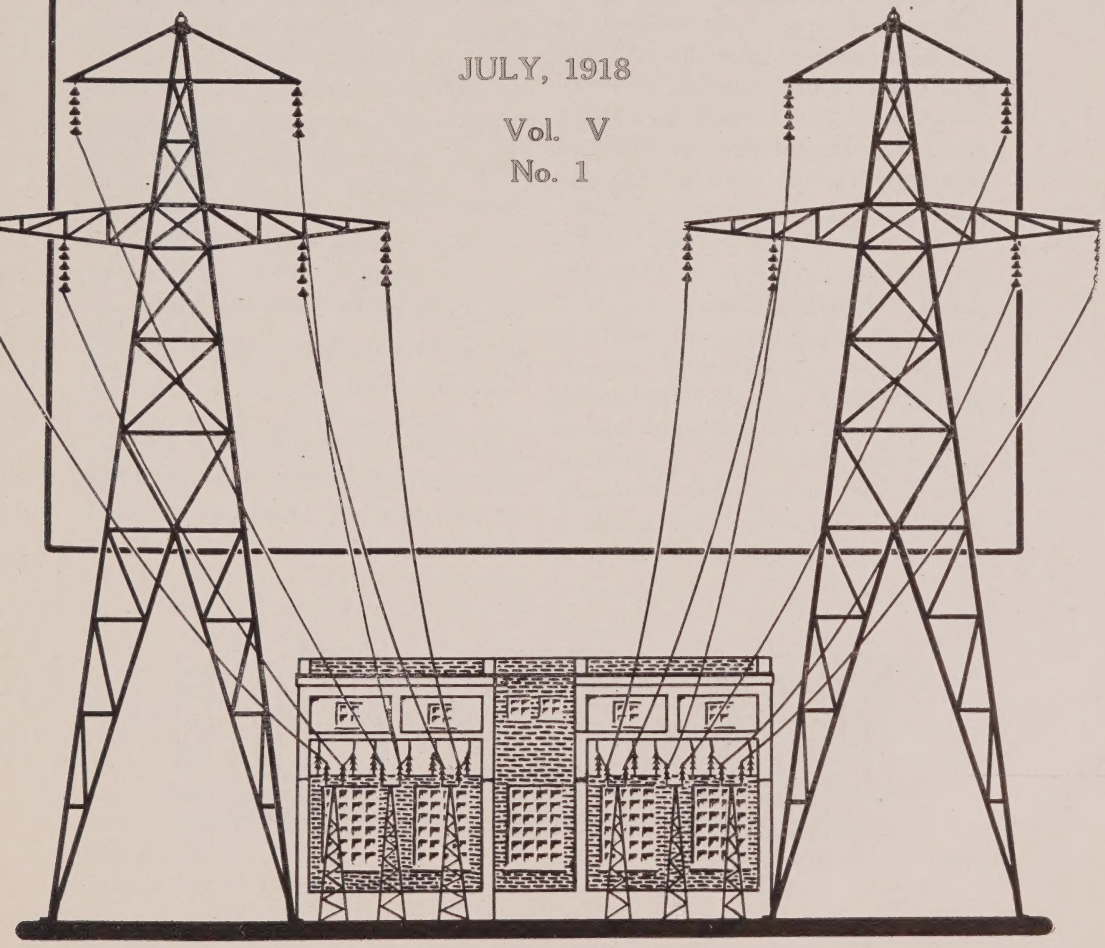


EDITORIAL

A.M.E.E. Convention

THIS, the Convention number of THE BULLETIN, contains an unusual amount of interesting material relating to the recent Convention at Niagara Falls.

The first Annual Convention of the Association of Municipal Electrical Engineers was, from every angle, a big success. The papers, without exception, contained valuable information for the member Municipalities, and the interest of the delegates was well evidenced by the amount of discussion which the different papers aroused.

In admitting to membership in the Association dealers of supplies and equipment, the Association has taken a step along the right lines. It is very evident that a common meeting of commercial men and Municipal Managers must result in a better understanding all round.

Fall Lamp Advertising

THE Commission has just completed the preparation of an unusually fine series of lamp advertisements which will appear in various newspapers throughout the Province next fall.

Both from art and copy standpoints, these are some of the best advertisements which have ever appeared in Ontario newspapers, and we feel confident that they cannot result in other than materially increased lamp sales for all Hydro Municipalities.

Details and proof sheets showing these advertisements will be mailed to the different Municipalities in a few weeks.

Association of Municipal Electrical Engineers

Convention at Niagara Falls, Ont., June 14 and 15, 1918

Minutes of Meeting, June 14th.

THE Delegates, Associates and Visitors met at the Restaurant, Queen Victoria Niagara Falls Park, being the convention headquarters, during the forenoon of this day for the purpose of registration. Immediately after this parties were formed who visited the generating and transformer stations of the Ontario Power Company and of the Hydro-Electric Power Commission of Ontario.

Afternoon Session

The meeting was called to order at 3 o'clock.

The President, Mr. E. V. Buchanan, spoke approvingly of the manner in which the Municipalities had responded in building up the Association, and welcomed those who had come as visitors. The minutes of the last meeting of the Engineer's Section of the Ontario Municipal Electrical Association were passed without being read.

The Secretary, Mr. S. R. A. Clement, reported as to the efforts to obtain membership for the Association.

A letter from Mr. E. V. Pannell, Secretary, Toronto Section, A.I.E.E. and dated March 21, 1918, was read. This suggested the formation of a Canadian Institute of Electrical Engineers.

The meeting was advised of an invitation that had been received from the Canadian Crocker-Wheeler Company for the Association to visit its plant at St. Catharines.

The Chairmen of Standing Committees, Messrs. Oswald H. Scott, Membership and Credentials Committee, E. J. Stapleton, Entertainment Committee, V. S. McIntyre, Papers Committee, and R. H. Martindale, Rules and Regulations Committee, reported that the statements already submitted and the program left nothing to be added by them.

Moved by Mr. Oswald H. Scott and seconded by Mr. P. B. Yates:

That the names of Messrs. J. F. S. Madden, W. M. Bostwick and W. H. Mulligan be added to the list of Associates of this Association. Carried.

Messrs. L. G. Ireland, Oswald H. Scott and P. B. Yates were named a committee to report regarding insignia.

Moved by Mr. P. B. Yates and seconded by Mr. V. S. McIntyre:

That the letter from Mr. Pannell be referred to the Executive Committee for report. Carried.

The following amendments to the constitution and By-laws were passed:

1. The words "at general meetings" were inserted after the word "rights" in the first clause under Privileges, making it "Class A——

2. A Commercial Membership was added, being open to manufacturers, contractors and dealers in electrical equipment and supplies dealing directly with the member utilities or their agents. Commercial Members have no voting rights or rights to hold office. The annual fee is $10.00.

3. Railway fares of members of the Executive Committee while attending Executive Committee meetings are made payable by the Association.

4. Provision is made for five district Vice-Presidents, who constitute the membership and credentials committee. They are to be chosen, one from each of the following districts:

Niagara District, Georgian Bay District, Central District, Northern District, Eastern District.

Mr. H. F. Strickland then read his paper entitled "The Evolution of Electrical Inspection in Ontario."

The Evolution of Electrical Inspection in Ontario

By H. F. STRICKLAND

Chief Electrical Inspector, Hydro-Electric Power Commission

ELECTRICAL Inspection in Ontario dates back approximately to the year 1892, as near as I can recollect, a year or two after what was then known as the Toronto Incandescent Electric Light Co., was established. At that time I was connected with the old Incandescent Company under Senator Frederick Nicholls and had a good deal to do with the obtaining of contracts for the installation of wiring and motors in Toronto, the estimating on these jobs and looking after this part of the work generally.

Electrical Inspection at this time was introduced by the Fire Underwriters as a precautionary measure and what inspection there was then was in charge of Mr. A. Bruce Smith, then Superintendent of Construction for the G.N.W. Telegraph Co., and now Manager of Telegraphs for the Grand Trunk Pacific Railway. The peculiar part of the situation in those days was that inspectors carefully and in due form certified to what we now would just as carefully condemn. This was not, of course, through any fault of the inspectors. In those days I can distinctly remember the lay-out of wiring jobs and often think how different they were from the present day and more often what would occur in Ontario to-day if wiring was still performed in the same manner. No doubt you have

all used the argument and had it used in turn upon you, at least I know we have, that because a wiring installation as performed twenty years ago did not always burn the building down the first night it was connected up, that it is just as good as the work done to-day and that there were not any more fires then than there are now. This statement may sound perfectly logical to anyone who wants to believe it without knowing the facts.

In those days I knew almost every installation which was connected up in the City of Toronto, and practically every wiring job which was being done in the same city. Toronto was at that time a city of considerable proportion and population and it was not very long after that when there was a very large building boom. Nevertheless, when there were three or four wiring jobs being done at the same time, things were what we might say "humping."

In the year 1892 and the two or three years following, wiring was installed in a variety of ways, which to say the least would be startling and interesting to behold at the present day. I can at the moment clearly see, with my mind's eye, the wiring in a building in Toronto which has since been pulled out which consisted of rubber-covered wire threaded through the joists with gimlet holes and then tacked on to the brick walls between the strapping with pieces of tape and a nail, much in the same way as a Virginia Creeper would be trained up the side of a house. When these wires, or electric creepers, were carefully tacked on the walls they were then covered in with fresh wet plaster. These circuits were ostensibly protected by wooden cutouts dipped in paraffine with open fuse wire and then mounted in wooden pockets in the walls, strictly without asbestos.

The chief form of protection and general finish in most wiring was a good daubing up with P. & B. Compound, which was commonly known as "stink." So long as a wireman could daub a lot of P. & B., on the cutout box and generally daub everything up that did not look right electrically, it was generally considered a very good job.

The service equipment consisted generally of a piece of board nailed up some place handy ; it did not make much difference whether it was in a clothes-closet, basement or attic. The service wires came in from outside through a couple of gimlet holes in the board and after being wrapped with tape they generally ran directly to the branch cutouts after passing through an Edison electrolytic meter. No doubt, theoretically this meter was the most accurate registering meter which was ever produced, but no doubt before the customer received his bill there were several inaccuracies which might creep in, such as the weighing of the elements and the recording of same in the books, and ultimately the computing of it in dollars and cents. Of course, we know that no one in the electrical business would think of increasing a customer's bill, but I

merely point out what an easy matter it would be with meters of this description for someone to read these meters as high or low as was considered advisable or necessary.

When this meter was installed on the board, the meter board such as it was was likewise well daubed up with "stink" and the service was completed in due form.

The salvation of a great deal of the wiring in those days was undoubtedly owing to the high-class of wire used. Rubber-covered wire was very superior, and I may say vastly superior, to the wire which has been used in Ontario up to the last year or two, in fact rubber-covered wire became a standing joke and I have heard it stated on good authority that one manufacturer made the broad statement that he was making rubber-compound for wire without using any rubber. The new Code rubber-covered wire which is required to-day is, however, very much superior to that which has been used during the past ten or fifteen years but I doubt very much whether it is as good as the rubber-covered wire which appeared in the early part of 1900.

It does not require a very great amount of abstruse calculation to answer the question touched upon a few moments ago as to why there were no more fires at that time than there are to-day with all our modern improvements one has only to consider the ratio as between the amount of current used then and at the present time, to answer this question. In those days the large percentage of electric light, especially in the large cities, was direct current, and the question of break-down between high and low tension and the grounding of secondaries did not enter very largely into the question at all, until some few years later and where there was one building wired up in those days there are many hundreds to-day.

It now seems an opportune time to pass some comments on the Electrical Inspection of the past and present. In doing so I wish to make it very plain that I do not wish to reflect in any way upon the past inspection or anyone connected with it. One might as well criticize the efficiency of a soldier with the old flintlock musket and the marksmanship of a crack shot armed with a modern Enfield rifle. The present inspector is vested with Rules and Regulations which are the outcome of past experience, and now enjoys a legal status which did not exist in those days.

The Fire Underwriters, who inspired the first production of an electrical code, did not do so out of love for their fellow men but as a protection to themselves and no one should blame them for having so done. It seems to me that when an aggregation of companies is expected to pay for fire losses that they have a right to know what they are paying for. The motive of the Underwriters' Regulations has always been the protection of buildings against fire, and they did not pretend to make regulations for the protection of life, although there are a certain

number of rules in the National Code which have been adopted for that purpose, but only recently.

A few years ago, practically the only inspection which was carried on in the North American Continent was that of the Underwriters' Inspection Bureau in the different cities and towns of Canada and the United States. This has been followed in recent years by some of the cities, where civic ordinances were passed causing Electrical Inspection to become mandatory. In most cases the Underwriters objected to anyone doing Electrical Inspection but themselves. Possiblly they are to be excused for this attitude, owing to the fact that they are paying for the losses. I know that at the present time the Fire Underwriters frequently hand me some comments to the effect that our Electrical Inspection is far from being as effective as it should be, and it was only during the last month that I was told by the chief official of the Underwriters' Association that we are unable to carry this inspection as far as we should and in many respects it is a failure. This, of course, was said to me in an apparently friendly spirit and no doubt this body sincerely believes this to be true.

There is only one system of Electrical Inspection which will ever satisfy the Underwriters (and this is said with the best feeling and with all deference to them) and that is a system of inspection which will not allow any electrical work to be installed in buildings at all, nor any electric current to be supplied thereto and the only electric light which should be permitted in buildings to be in the form of portable flashlights. Such a condition would be ideal for the Fire Underwriters as there would be positively no fire losses from electrical causes.

Commenting further on the attitude of the Underwriters towards this inspection, I think the chief trouble is that they have not really seriously analyzed the work of the Inspection Department or made a fair comparison as between what is being done now and what was done in the old days. Having been Chief Electrical Inspector for the Canadian Fire Underwriters Association for a period of five years I think that I can justly claim to know as much about the subject as anyone else. As a matter of fact, I was the first inspector employed by the Underwriters who was called upon to devote his whole time to organizing and enlarging the whole system.

When I took over Electrical Inspection in Toronto some twelve years or more ago, the entire work was being carried on by Mr. Smith, who was Superintendent of Construction for the G.N.W. Telegraph Co. No one who knows Mr. Smith would say anything about him except what would be favorable from every point of view. Mr. A. B. Smith enjoyed the respect and admiration of everyone who knew him and undoubtedly if he had the opportunities which I have had and had devoted his whole time to Electrical Inspection he would have made a great success

of it and my effort would have looked very small in comparison. At that period, however, Mr. Smith's time was very largely devoted to the work of the Telegraph Company and as there was no law requiring inspection, no one was obliged to have work inspected. Such conditions tended to produce chaos. For instance, no wireman could tell whether to figure on a good job or a bad one. The general result with the wiring was that a good contractor wished to do a good job and only did so when he had the work at his own price, or after having ascertained who was competing with him. If only two or three good wiremen were asked to figure on the job there was some chance of getting a fairly good job done, but if two or three cheap men had a hand in the pie, chances were that the job was a poor one with no guarantee that it ever was inspected, in fact it often was not. As soon as it was ready (and often before) the electric light company would issue a service certificate.

I can remember in the early days of the Toronto Hydro, where rows of houses were being built, it was often a race between the Toronto Electric Light Co., and the Hydro for service and I have seen one or the other of these supply authorities install services in a whole row of houses before they were lathed and plastered, and put the meters in and turn on the current. This was a very undesirable state of affairs and it was a wonder that there were not a number of people killed or a number of fires resulting from this mad rush for current, regardless of the safety of others.

I distinctly remember one case where a couple of Italians were digging in the cellar of a house when one of them happened to touch the main switch. He got a nasty shock and out of retaliation he took his spade and smashed the meter and everything else to pieces.

Things became worse and worse and I have known cases where the companies forgot whose meters were whose. I remember another instance where a Hydro meter was in a house and was connected up to the Toronto Electric Light Co's. service wires, so that one company was deriving a revenue from the other company's wires through their own meter. Jumpers around meters to shut them out altogether was also a very popular past-time in those days and no one need be deprived of service owing to a blown fuse so long as there was a wire nail or a pant button not working. But this was not all. There were a few legitimate wiring contractors in Toronto and vicinity and a score or more of people doing wiring (with the accent on the *doing*) ; and not only doing the wiring but also the people for whom they were doing it. You can judge to what an extent this was carried when I tell you that I know of a row of houses in which the wiring was let to some itinerant contractor and the builders, after having paid this contractor about 85% of his total contract (of course without inspection) suddenly discovered that there were no wires

in the houses at all, but the contractor had merely wired up to the outlets and succeeded in some way in having it lathed over before his little joke was discovered. In other words, the woods were full of carpet-bag contractors, boys and other amateurs who considered themselves quite competent to wire up anything as they felt disposed.

I have in this paper so far alluded chiefly to the conditions in Toronto. This is owing to the fact that Electrical Inspection in Ontario was very largely a matter of Toronto. There was a little inspection done on the side, consisting of the local managers of the G.N.W. Telegraph Co., in Hamilton, Brantford, and Kingston and only after I took over the Underwriters' inspection there was an inspector appointed in the City of Ottawa.

To make a long story short and to make a fair comparison of the conditions which exist to-day as against those existing in the days of Underwriters' inspection, one has only to state that to-day in the Province of Ontario there is not a square inch of territory left uncovered. Electrical inspectors are now duly appointed and have been carrying on their work in the different districts extending from Windsor to Ottawa and from the very southernmost part of the Niagara Peninsula right up to Kenora, Sudbury and Timmins on the north.

Touching on Electrical Inspection as it is to-day one of the most important requirements, in fact I believe that it is the very backbone of the whole inspection system, is the Permit which is required before the work may be performed. If the law merely called for an application for inspection on all work as performed or that had been performed, it would not begin to be as effective as the Permit. Any itinerant or other doubtful wireman could always make the excuse that he intended having the work inspected. This excuse could be raised a day, a week or if necessary a year after the work was done, but the Permit to perform the work clinches the argument at the start and I believe it has been the means of weeding out more doubtful and inferior wiremen than any step which has been taken, and I am glad to say that the Commission has supported us in enforcing this requirement.

The energy of the Inspection Department has not been solely devoted to the inspection of new work either, as the following figures will show: From June 1st 1917, to May 11th, 1918, the sum of $241,936.46 has been expended by electric light consumers, owners of buildings and other responsible, in removing dangerous and doubtful wiring and these figures would have been much greater were it not for the abnormal price of labor and material.

In addition to this we have annual contracts with 455 manufacturers and other concerns which entitle these parties to a monthly inspection of their works. These monthly inspections have proved so satisfactory that the larger proportion of them were renewed this year and such as dropped out

"AT THE CONVENTION"

1. *The "Convention Special."*
2. *H. G. Acres, Hydraulic Engineer.*
3. *F. A. Gaby, Chief Engineer.*
4. *Viewed along the Canal Site.*
5. *Boarding the "Convention Special."*
6. *J. F. S. Madden, who read a Paper on Sales Service.*
7. *Convention Officials — Messrs. Scott, Buchanan, Ireland, Martindale.*
8. *M. J. McHenry, who read a Paper on Synchronous Motors.*
9. *Convention Headquarters.*

have been replaced with new ones. I have not heard of any inspection department on this Continent which carries on a system precisely the same as this, nor do I know of any department where the Permit system is as strictly enforced or as generally uniform as it is in this Province. There are a few departments in the States where they have local by-laws, each with its peculiar differences in law and interpretation but I do not know of any district as vast as Ontario which is under one administrative head and which is under the same uniformity of law and interpretation as this.

Nor are we behind the times in our methods of construction. In many up-to-date Inspection Departments in Canada and the States the open switch and service equipment is still accepted as O.K. I have seen electric services in many cities in the States and Canada and do not know of anything which is more up-to-date, more finished looking, safer or modern than our iron-clad service equipment, especially when hitched up to an A-1 conduit installation.

At this juncture I would hint at an innovation which is likely to materialize in the very near future, in fact before this paper is read it may have become a reality, and that is a new method which has been submitted to the Commission and approved, covering the installation of electric fixtures. This system does away at one sweep with all the objections to the hanging of and wiring to the fixtures at the outlets. Of all the dirty jobs in the wiring of a house, the hanging of a fixture is the meanest to be found. Anyone familiar with house wiring knows that under the fixture canopy is the weakest spot in the job. Often we find here a mixture of crowfeet, joints in wires and screw nails, all jumbled up in a heap right at a hole in the ceiling where shavings and other inflammable material accumulateand where a fire can be beautifully encouraged with the draught which is so common between joists in any building.

I remember quite clearly an incident in a large city in Ontario where a transformer broke down one afternoon and something like twenty-two fires developed in a few city blocks supplied from this large transformer.

I examined a number of these installations and in nearly every case the fire broke out under the fixture canopy. The new method referred to will enable a school child to install the ordinary electric fixtures in a house with a twist of the wrist. The brackets can be put in as easily as an electric iron can be attached to a receptacle and the only difference with the pendants being the assistance of a step ladder, and fixtures can be removed just as easily and quickly. In order to make this method of installing fixtures possible and to facilitate the adoption of same, the Rules and Regulations of the Commission will be amended to call for outlet boxes on all outlets in connection with knob and tube work, now only a recommendation. The added cost of an

outlet box is a small matter and the first installation of fixtures on a job will more than pay the entire cost and it will be a gain each time fixtures are put in and taken down.

The enforcing of electrical inspection sometimes appears different to the inspected then it does to the inspector and we meet with all kinds of people and all kinds of arguments. In all fairness to the Electrical Inspection Department it must be conceded that in order to carry on a system of inspection it is first of all necessary to have a set of Regulations and by the very nature of electric construction it is demonstrated that they must contain a great variety of detail and figures. There are times when the enforcing of a Regulation may appear arbitrary. On the other hand, a little laxity may appear to the other fellow as rank favoritism. This depends entirely upon the attitude of the parties interested and whether they are the inspected or the inspector.

We have endeavored in every possible way in enforcing these Rules to keep the new work strictly up to the Rules and Regulations. This seems to be the only way to give ultimate satisfaction and I think I can safely say that the majority of the best wiring contractors and parties interested in Ontario appreciate this fact. By so doing, all contractors and others are placed on a fair basis when estimating on work, and if not now, perhaps sooner or later people will feel that they have some measure of protection when letting contracts for wiring when they call for the production of the inspector's certificate.

Neither the writer nor any of the inspectors on this staff claim to be a finality on everything electrical,—far from it. I do claim, however, that every man holding a position as electrical inspector on the Commission's staff has been a well-trained journeyman wireman before he commenced his training as an inspector, in fact the large majority of these inspectors served many years in the electric wiring trade with the largest and best-known electric concerns in Canada and the States, and not only were they familiar with the trade itself but were well posted on the tricks of the trade.

There is an old saying that "it takes a thief to catch a thief" and the varied tricks of shady wiremen and contractors are quickly detected. Not only must inspectors keep abreast of the wiring trade and the development of this art but they must keep thoroughly familiar with every fitting which is used, just why it is used and whether it is real or imitation, and incidentally keep track of the doings and sayings of all the different wiremen and their peculiarities.

We are frequently confronted with electrical installations which are *almost* in accordance with the Rules. This is a very distressing condition because if one person is permitted to get away with work that is almost right, the next contractor is prone to take advantage of it, and so on, all down the line and eventually the rule which has been almost broken will become very

much dislocated and openly violated in the long run.

It would take a great deal of time and space to intelligently record and put into interesting reading form all the idiosyncrasies of the Electrical Inspection business. There are many things we would like to speak of and some things for obvious reasons we cannot, and in touching on these questions of the tricks of the trade we do not like to pass over the point without speaking in no uncertain terms of appreciation of the co-operation we receive from regular bona fide contractors and their affiliated organizations.

We have tried in every way to improve the wiring conditions and bring electrical construction and inspection up to a high and sane standard in this Province and we hope to continue to do so, as long as we receive the support which we now do from the Commission and the co-operation which is enjoyed from the contractors and others.

With the foregoing remarks I will bring this paper to a close. If my subject has proved at all interesting and there is any discussion to follow I would be glad to hear any suggestions or questions which may arise and in concluding I can only say that Rome was not built in a day and I think I can fairly claim that our efforts in developing this inspection work in the Province have met with at least some measure of success and that no stone will be left unturned to further improve conditions. All I ask is that hasty judgment or destructive criticism be avoided.

It is unnecessary to reassure you that the Commission desires that we use every discretion in administering these Regulations and has pressed upon us this desire and it will be our duty to see that every inspector carries these orders out, and it is very gratifying to me to be able to say that considering the magnitude of this Department and the enormous amount of work which passes through our hands, the complaints are comparatively very few and the justification for complaint is even smaller. No one need have the slightest hesitation in submitting complaints to us and we especially welcome constructive suggestions.

I thank you for your kind attention.

Discussion by Messrs. J. J. Heeg, Oswald H. Scott, P. B. Yates, Geo. Grosz. R. H. Martindale, A. T. Hicks, Geo. E. Whiton, Gordon Kribs and the President followed this paper.

Moved by Mr. Oswald H. Scott and seconded by Mr. A. T. Hicks:—

That the Hydro-Electric Power Commission be requested to add The Chairman of the Rules and Regulations Committee to the Committee which draws up the Rules and Regulations. Carried.

Moved by Mr. A. T. Hicks and seconded by Mr. W. J. McIntyre:

That the Secretary be instructed to write a letter to the Hydro-Electric Power Commission, requesting an answer to our letter regarding the changing of the name of the Electric Inspection Department. Carried.

A hearty vote of thanks was extended to Mr. Strickland for his efforts.

Mr. Heeg, Guelph: I agree with what the Hydro-Electric Power Commission is doing and there are a lot of things which the Inspection Department can tell us. I would like to ask why the conduit in a service cannot be used as one wire, thereby dispensing with one conductor?

Mr. Strickland: While I have every respect for Mr. Heeg, there are different phases of his question which should be considered. It is not always well to be governed entirely by the question of cost as sometimes what might appear to be a cheap method may prove more costly in the end. In the first place, notwithstanding our Rules and Regulations and the Act of Parliament behind them, the Underwriters who control the insurance on most buildings do not approve of the method suggested by Mr. Heeg. His suggestion is by no means a new one, it having been brought up and thrashed out by the various inspection departments and engineering societies throughout the States and Canada, and inasmuch as all these bodies have been seen fit to discard it, it has not been seriously considered in this Province and it would be detrimental to the interests of all parties concerned for the Commission to adopt Rules which would not be acceptable to the Underwriting bodies which, after all, control the situation.

The Underwriters are now entirely satisfied with our present Rules and Regulations and it would be obviously burdensome to have two sets of Regulations in this one Province. If we had such a rule, we could of course certify that the installation in a building was in accordance with our Rules, and issue permit for the use of current, but there is nothing at present to prevent the Underwriters from objecting to it and imposing a surcharge on the rating if they considered it dangerous.

If Mr. Heeg really desires to have this matter thrashed out or re-considered, I would suggest that he communicate with the Commission, requesting that it be considered by the Rules and Regulations Committee and at this juncture I might mention that the Commission has approved of the addition of five outside representatives on this Committee. I, for one, do not propose to stand in the way of advancement or the acquisition of any knowledge which will tend to improve conditions but at the present moment I am not at all favorably impressed with the suggestion.

Mr. Scott: Mr. Strickland has given us the evolution of Electrical Inspection. I think we would be interested to know the evolution of the Rules, or in other words: What must be done to make a rule legal?

Mr. Strickland: In answering that question I would point out that the Rules and Regulations of the Commission started practically where

the National Code left off. Originally an attempt was made to draft an entirely new set of Regulations. The result was not satisfactory. For instance, provision was made in the proposed Rules for some six or seven different weights of conduit instead of one standard which we now have. It would not be difficult to imagine the enormous stock which would necessarily have to be carried if such a condition were permitted, and again, there would be eternal strife as to what weight of conduit would be permitted in the various classes of installations and the trifling saving in the weight of the conduit would be more than lost in the confusion, the capital investment and interest on unused stock, to say nothing of the loss of time and the inevitable mistakes which would occur on the part of contractors in making improper selections of conduit. I am glad to say that this method was not adopted by the Commission.

The Rules and Regulations of the Commission differ from the National Code only in so far as protection to life is concerned. In this respect the Code was lamentably wanting, whereas the Commission's Rules and Regulations, I believe, are the most complete to be found on this Continent.

Should the addition or amendment of a Rule be necessary at the present time the proposed amendment is brought before the Rules and Regulations Committee and discussed. If it is adopted the recommendation is submitted to the Commission for approval. It is then approved by Order in Council and when this formality is completed it is then a law of the Province. There are several amendments now awaiting this Order in Council and which will, when approved, be added to our present Rules and Regulations.

Mr. Scott: That is all right for some of the societies that are well represented on the Board that draws up these Rules and Regulations, but I think the men in the field who is actually in touch with these conditions will be no better off as he has no chance to comment upon the Rules and Regulations that are from time to time brought up before the Committee on Rules and Regulations and as we have a Rules and Regulations Committee, I would like to see the chairman of that Committee appointed from Class A members of the Association. I think Class A men ought to be represented, not necessarily in place of one of the Associate members, but they ought to be represented.

The President: I think Mr. Scott's suggestion is a very good one, but it must also be remembered that this Association is not strictly a Hydro one, but it is simply a Municipal Electrical Engineer's Association covering all municipal electrical utilities in the Province and it seems to me that this body ought to be officially represented on that committee. Of course, probably Mr. Strickland will say if that is done then the private companies selling electrical energy will also have to be represented.

Mr. Strickland: I quite appreciate Mr. Scott's suggestion. I have nothing to sell and any help I can

Electric Locomotive used for hauling on disposal railway

get and any suggestions are absolutely welcome, but I would say that inasmuch as we now have seven of you on the committee I do not think that we need more. I would think it would be enough if you appointed one of these men to represent the Association.

Mr. Scott: I do not think they are as well qualified to criticize as a man who is in the field. Then the Toronto members are only associate members, I think it is the men who are right out in the field that you would get the best results from. You say in your paper all men holding positions of electrical inspectors on the Commission's staff have been well-trained journeymen wiremen, but these men who are drawing up the Rules and Regulations are not journeymen wiremen and I think that those are the men who ought to have something to say in the making of the laws.

Mr. Strickland: In answering that I might say that I keep in very close touch with all my inspectors with respect to every change in every rule. I send out circulars and get every man's opinion. It is a question for the Commission to decide whether they want to enlarge that Committee. It might be very good so far as attendance is concerned, we never have too large an attendance at any time and the more the merrier. We would be sure to get five or six in that way anyway. If the outside members are so interested in our work, they no doubt will show up too. I do not wish to put any stumbling-block in anyone's way at all.

The President: We must also remember that these gentlemen are employees of the Commission. The Commission makes the rules and they do not feel so free to express opinions as those of us who are not in the jurisdiction directly of the Hydro-Electric Power Commission.

Mr. Kribs: In answer to Mr. Scott, that the men of the various towns are afraid to express their opinion. I think in each case the district engineer should be a member of this committee and the local committee should tell their troubles to the engineer and I think he would be the proper party to take it up with the Rules and Regulations Committee.

Mr. Scott: I think, no doubt, Mr. Kribs observes all the Rules that come in force and we don't prevent that. I would like to make a motion to the effect that the Hydro-Electric Power Commission be requested to add the chairman of our Rules and Regulations Committee to the Commission's Committee which draws up these Rules and Regulations.

Mr. Strickland: What are some of the Rules that you object to?

The President: I am afraid there are too many.

Mr. Strickland: There is no use putting in negative objections. You must bear in mind, with due respect to your Hydro men, that there are also a lot of private companies with men in the field. For the sake of argument we will assume that the private companies and the Hydro are about six and six. There are also the supply companies and the manufacturers, to say nothing about

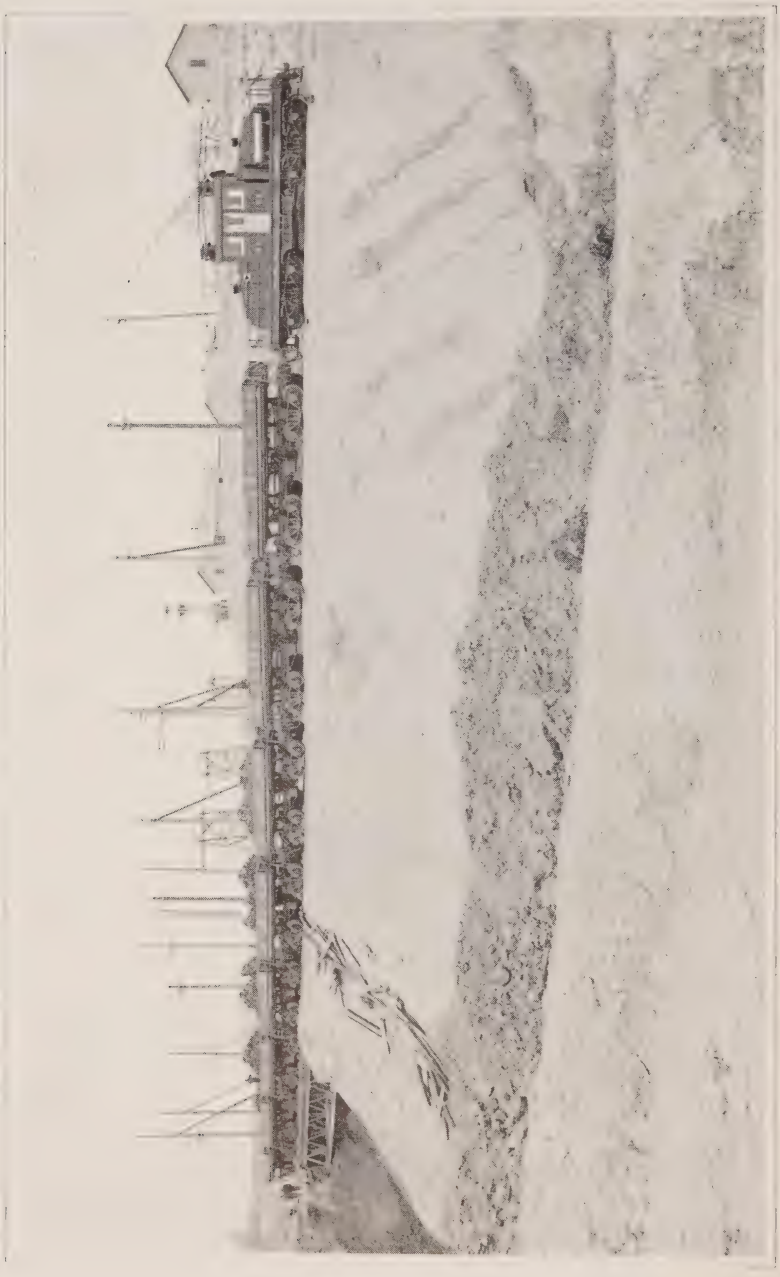
Electric Shovel which lifts 8 cubic yards of earth—70 feet

the contractors. The Inspection Department must inspect for all parties alike and should not be subject to undue influence on either side. I can assure you that it requires a good deal of diplomacy and care, to say nothing of fair judgment, to satisfy all these private companies that we are dealing with them fairly and granting no favors to institutions bearing the name "Hydro." We also have to deal with the Underwriters, who already criticize our Inspection Department more or less. They seem to think that our Rules are going backwards. For instance, they consider the permission of 2,200-volt wiring in conduit a step in the wrong direction.

The Commission's Rules permit the use of rubber-covered wire in conduit whereas the Underwirters' Rules require lead cable. Ours originally did the same. The Underwriters now claim that the Inspection Department was forced to change that rule because the Hydro was doing wiring that way. I therefore think we should be very careful not to leave any openings which could be criticized. In the making of such rules all parties should have an equal voice. The change, however, may prove to be all right in the long run and I am prepared to give it a fair trial. My prejudice, however, is in favor of lead cable.

A lot of these private companies and the Underwriters often make the remark that "you fellows meaning the Inspection Department, and the Hydro interests make rules to suit your own jobs"; but I can assure you that our Rules are made and enforced just as impartially as though the Inspection Department were in no way connected with the Hydro. I am trying to impress upon the general public that by our Rules and the way they are enforced we are fair to all parties concerned. Sometimes you speak of these rules as my rules. They are not my rules, but the Rules of the Hydro Commission and I think that what the Commission has adopted and done in the past should be sufficient evidence of good faith.

Mr. Yates: I don't think there is any larger Association interested in these Rules and Regulations than this Association right here. Taking it as a whole, I think that the municiaplities interested in this Association combined are almost as large as Toronto. Mr. Strickland says that he is very anxious for all these opinions and wants the best opinions that can be obtained, and he would like to have a large committee and as many attend as possible and get a thorough discussion from all points of view. Toronto has five members. The jobbers and manufacturers are all represented. The Toronto Board of Trade is represented. The rest of the Province is not represented in any way, shape or manner. If this is going to make it easier for some of the manufacturers to get their complaints discussed by the Committee or to bring up any suggestions to the Committee, I can see no destructive criticism or cause for Mr. Strickland's question as to what rules we object to. It is not that. All of these things taken together make me believe that it would not be harmful to have an additional member and possibly it would be a



An Electric Locomotive and Train of 20-yard dump cars

good thing and it certainly would be a good thing for the municipalities and I would heartily approve of the motion before the House that such a representative be appointed from this Association.

Mr. Martindale: I would move an amendment that the President of this Association represent this Association on the Rules and Regulations' Committee of the Hydro-Electric Power Commission.

The President: I might say in response to your motion that we have comparatively few of the troubles that you men been complaining of. We do not do any local wiring and generally our friction with the inspection department has been practically nil. For this reason I feel that I am not in the same light as some of the other municipalities and would not be a proper representative. I think you ought to appoint a representative from the Association without naming any specific bearer.

Mr. Hicks: I second that.

The President: Is there any further discussion on the motion that the Hydro-Electric Power Commission be approached with a view to authorizing a representative from the Association on the Rules and Regulations' Committee who will be named by the Chairman of the Rules and Regulations Committee.

Seconded by Mr. Hicks. Carried.

Mr. Grose, of Waterloo: Before we had the approved service boxes it was necessary to have a meter-board of asbestos. To my mind we could do away with that asbestos meterboard. I think that could be dispensed with. It seems to me it is more for appearance.

Mr. Strickland: As I said before, what is the use of us making Rules if we cannot enforce them? That is another thing that is controlled by the Underwriters.

The President: They should not have anything to say in the matter at all. As I understand it at the present time there is a Commission sitting on that very subject and it is to be hoped that very soon the Government of Ontario will control insurance rates instead of the Underwriters. Most of you who are also managers of Waterworks Departments know that the Underwriters are very arbitrary. They are making absurd demands and the sooner they have no more to say about the making of insurance rates, I think, the better.

Mr. Strickland: What I want to impress upon you is not the question of whether the Underwriters are right or not, but I mention the fact that at the present time the Underwriters control the insurance companies. There are only two or three companies that are not controlled by the Underwirters. Some people imagine that they are a body of people who are never seen and that they say a thing and nobody can dispute it. The Underwriters in Canada to-day are known as the Canadian Fire Underwriters' Association. That is to say, all the tariff companies or the old stock companies and no doubt they are the best companies, they get together and they say "we are the underwriters." In this way the manager of every company is a

Assembling the world's largest shovel. It is electrically operated

member of the Underwriters' Association. I think there are fifty-six companies. They open an office in Toronto and they charge all the companies pro rata on their income to defray the expenses of the Underwriters' Association office. They can say "We will have to charge two dollars now where we have charged only one, because they are using Hydro power." "Unless you supply a steam pump we will charge you two dollars"—and they don't care whether you do it or not. In the State of Texas they passed a law controlling the rates and the results was that the insurance companies closed their offices and business was paralyzed. That is the problem the Hydro Power Commission is up against. In telling these things I am only explaining the organization you have to deal with.

With regard to the question of leaving off the asbestos. Supposing a company finds that you are not using any more asbestos and the next day a fire is proven to be caused by that neglect; would it not look a little peculiar when all the rest of the Continent has found that it should be there, and the Hydro Commission would say that it should not be there? I do not think myself that meters should be placed on dry boards without protection.

Mr. Hicks: What was done with that petition that was sent to the Commission about changing the name of the Inspection Department? If nothing has been done I would ask that a letter be sent to the Hydro-Electric Power Commission regarding the same.

The President: It was presented to the Chairman and he promised to see that it was given consideration. Since then we have not heard anything about it and I think we ought to get right after it, requesting an answer to our letter regarding a change of name.

Seconded by Mr. W. J. McIntyre. Carried.

Mr. Whiton, of Dundas: Regarding service boxes being sealed by the authorities, I know in Dundas we are often called out to put a fuse in a service box and nine times out of ten we find that the fuse in the box is defective. Don't you think that a small house should have more than one circuit?

Mr. Strickland: It is very refreshing to have someone ask such a question. We have not the slightest objection to anyone having it even divided nto five circuits for the one house. We only ask for the minimum requirements but we always urge the extra auxiliary fuse and the way the rules and regulations are now it would be a very small house that would not require the extra fuse.

Mr. Whiton: All our small houses have only one service box and the jobs are passed by the inspectors. I understand that in Strathroy they have to put in two service boxes.

Mr. Yates: I cannot see that that would do any good because if there is only one circuit your fuse box would be an auxiliary; it would be going all the time. I cannot see that it would make a bit of difference. You would have to go around and keep your fuses in the sealed box just above the fuse out-

side or else it would keep going all the time. I cannot see that you could get away from that.

Mr. Martindale: I would take this opportunity to move a hearty vote of thanks to Mr. Strickland for his efforts.

Seconded and carried.

Mr. H. H. Madgsick next read a paper on "Factory Lighting."

This paper was discussed by Messrs. H. F. Shearer, E. M. Ashworth, Gordon Kribs and R. H. Martindale.

At the close of the discussion a hearty vote of thanks was tendered Mr. Madgsick.

Mr. Wills Maclachlan gave a demonstration of the Prone Pressure Method of Resuscitation.

The meeting adjourned at 6.30 o'clock.

Immediately after the afternoon session supper was served to the Association at the Restaurant, addresses were delivered by Messrs. Fred. W. Field, H. M. Trade Commissioner, Toronto, and Geo. C. Rough, Vice-President of the Packard Electric Company, St. Catharines.

Minutes of Meeting, June 15, 1918.

Morning Session.

The meeting was called to order at 10.00 o'clock.

The session opened with a paper entitled "Sales Service," by Mr. J. F. S. Madden.

Discussion followed by the President, Messrs. P. B. Yates, E. I. Sifton, V. B. Coleman, A. E. Jennings, *Canadian Engineer*, Gordon Kribs, J. E. B. Phelps, H. F. Shearer and H. O. Fisk.

Moved by Mr. G. E. Chase and seconded by Mr. E. I. Sifton:

That a hearty vote of thanks be tendered Mr. Madden for his worthy paper. Carried.

"The Commercial Application of Synchronous Motors" is the title of a paper read by Mr. M. J. McHenry.

The Commercial Application of Synchronous Motors

By M. J. McHENRY

Manager, Walkerville Hydro-Electric System

THE theory of the Synchronous Motor in its application as a power factor corrector, is familiar to every engineer, and is not greatly complicated. It is not the purpose of this paper to discuss this theory or to call attention to the most approved methods of design calculation. An attempt will be made, however, to point out the principal characteristics of this type of apparatus which make it applicable to certain classes of service, and further to discuss the industrial use of these Motors in relation to the central station and

its customers. A few remarks will also be included on the selection of the proper motor for different classes of load.

The discussion of the characteristics of Synchronous Motors can probably best be accomplished by comparing with those of the well known polyphase Induction Motor. Almost everyone to-day, is more or less familiar with the Induction Motor and its operation, since this type of Motor has been almost universally applied wherever electric power supply is available. In considering the industrial application of Synchronous Motors, such a comparison should be made with reference to the operation of the apparatus. This would call for a comparison covering—starting characteristics, ruggedness and durability of the equipment, simplicity of construction, efficiency and freedom from interruption of service.

The principal characteristic of the Synchronous Motor, and the one which gives it a commercial value, is its ability to maintain high power factor and, if necessary, to be used to improve a poor power factor due to other equipment on the system. For any given load, the Induction Motor operates at a constant power factor which is always lagging—the lighter the load, the greater the lag. The power factor of the Synchronous Motor, on the other hand, is always within the control of the operator, and can be made unity, lagging or leading at will, by manipulation of the field rheostat. This feature is of particular importance to the central station to-day, especially where there is long distance transmission and heavily loaded lines, or where the feeder regulation is poor. It also becomes of great interest to the customer whose power factor is low and who is, consequently, being penalized by the Power Company. This ability to correct power factor calls for the use of the Synchronous Motor commercially, to increase the capacity on transmission lines which are operating under an overload in current due to low power factor, to increase the capacity of transformers similarly overloaded, to raise the power factor of isolated industrial loads and to assist in maintaining the voltage of feeders and transmission lines within proper limits.

The starting characteristics of the Synchronous machine do not differ greatly from those of the Induction Motor, either machine drawing a heavy lagging current from the line if starting under its load. It must be remembered, however, that it is comparatively easy, in certain types of Induction Motors to so design them that they can come up to full speed with full load, and not cause a severe drain on the system. On the other hand, Synchronous Motors that can develop as good torque in starting up, are generally of quite special construction. Consequently, it is not possible to apply the Synchronous Motor to every service that can be taken care of by the Induction Motor. As the starting torque of the Synchronous Motor is usually obtained by means of Amortisseur windings, similar to the Squirrel

Cage winding in the rotor of an Induction Motor, it is possible to vary the torque by modifying this winding. Theoretically, this is a practical proposition, but for various loads, it is prohibited by the commercial cost of the design required. It is of interest to note that widely different characteristics can be obtained by the use of different materials and methods of design in the Amortisseur windings of a Synchronous Motor without serious detriment to the efficiency of the Motor, since it always runs in synchronism under load. On the other hand, the Induction Motor always has a slip with consequent losses in the rotor winding, which losses are increased with an increase of the resistance in the winding. The starting apparatus required for both types of Motors, is somewhat similar, but there is the additional complication, in the case of the Synchronous Motor, introduced by the D.C. field with its special exciter.

From a mechanical view point, there is no question but that the Induction Motor, with its absence of sliding contacts and its simply constructed rotor, lends itself to more severe service than the Synchronous Motor with its more complicated rotating field and auxiliary Exciter. From an electrical standpoint, the Induction Motor still has its advantage of simplicity since little auxiliary equipment is required for its operation and little attendance is necessary after it is once started. The Synchronous Motor, on the other hand, must have a separate D.C. Exciter with rheostats, field switches, etc., and good operation depends largely on the degree of field excitation given the motor.

With regard to the possibilities in efficiency, the Synchronous Motor, in its nature, has the higher efficiency at the higher loads and the Induction Motor, at the lower loads, this difference being due to the energy required for excitation of the Synchronous machine as compared with the rotor losses of the Induction Motor. In the Synchronous Motor, due to the larger air gap and the limitations in heat dissipation in the field coils, the excitation at "no load" is relatively high, but this excitation is not increased greatly at "full load." In the Induction Motor the secondary losses at "no load" are small as compared with those at "full load." In general, however, it is possible to obtain higher efficiencies with synchronous apparatus than with Induction Motors. As an example—let us compare the efficiencies of two machines of approximately the same size. *Fig. 1.* This figure gives efficiencies for a Squirrel Cage Induction Motor of 250 H.P. Capacity, 600 R.P.M., 2200 volt, 3 phase, 60 cycle, and also the efficiencies for a Synchronous Motor of 240 H.P., 600 R.P.M., 2200 volt, 3 phase, 60 cycle. Curve No. 1, gives the efficiencies for the Synchronous Motor at 100 per cent. power factor ; Curve No. 2, for the Synchronous Motor at 80 per cent. power factor leading ; Curve No. 3, the efficiencies for the Induction Motor, and Curve No. 4, the corres-

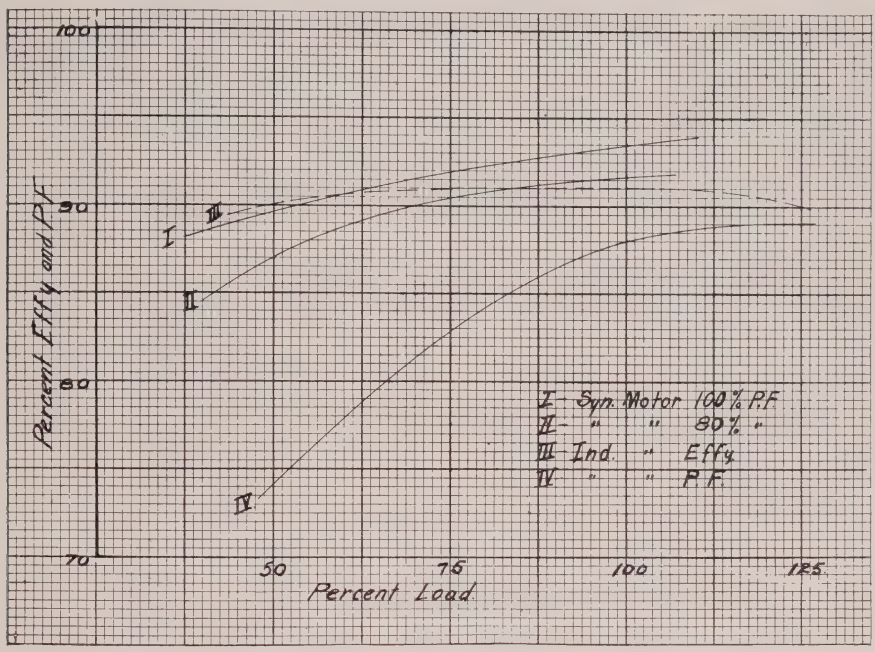


Fig. I

ponding power factor for the Induction Motor. It will be noted that at full load and ¾ load, the efficiency of the Synchronous Motor exceeds that of the Induction Motor, while at the lighter loads, the Induction Motor has the advantage. It must be remembered, however, that at the lighter loads, the Synchronous Motor has the advantage of maintaining a high power factor, while the Induction Motor, has a very low power factor, as will be noted from the Curve. Furthermore, the Induction Motor power factor is always exceedingly low compared with that which can be obtained from the Synchronous Motor. Extremely good efficiencies have been obtained with Synchronous Motors, the following being those obtained on actual test with a 250 H.P., 3 phase, 60 cycle, 4000 volt, 1200 R.P.M., Sychronous Motor for direct connection to Centrifugal Pump.

Full Load	95.3%
¾ Load	94.8%
½ Load	93.4%

The efficiencies to be obtained with a Squirrel Cage Induction Motor of the same capacity and rating, would be as follows :

Full Load	93 %
¾ Load	92½%
½ Load	91 %

From an efficiency standpoint, it would appear in general that better results can be obtained with the Synchronous Motor.

A valuable characteristic of the Synchronous Motor is the possibility of increasing its excitation

in such a manner that the Motor is not in danger of breaking down. It is well known that the maximum torque of the Synchronous machine can be increased by over excitation. This increase in exciting current can be accomplished by means of a field regulator actuated by automatic relays, or in the case of Motor Generator sets, by series coils on the motor fields, excited from the D.C. generator armature. The maximum torque of the Induction Motor on the other hand, is fixed for any one machine, provided the voltage is constant.

It is well known that once a Synchronous Motor has fallen out of step, the excitation must be reduced or entirely removed in order to get the Motor back into synchronism. This is sometimes used as an argument for the Induction Motor in cases where the line voltage is likely to be interrupted for a short time or drop to such a low value that the Motors fall out of step. This argument is questionable, however, as should full voltage come on an Induction Motor at rest or running at low speed, the draught of current would be so great as to trip the oil switch and necessitate starting up in the usual manner. It is the general experience in practice, that Synchronous Motors behave much better under such conditions as partial short circuit, or even the dead short circuit to ground of one phase of the line running to the Motor, than Induction Motors. This is due to the fact that the Synchronous Motor has its excitation supplied from an outside source and this excitation tends to raise the voltage at its terminals, rather than to reduce it when there is any cause at work on the lines tending to drop the voltage : and furthermore, to the fact that any given strength of field on a Motor, tends to maintain the ability of a Motor to carry load when the potential back of the Motor is reduced. On the other hand, in the case of the Induction Motor, any drop in voltage in the lines leading to the Motor must result in a still greater reduction of the voltage at the Motor and, consequently, an increased current to carry the load. This increased current, in turn, results in a still further reduction of the supply voltage and consequent dropping out of step. Before concluding the comparison of these two types of motors, it would be well to consider the question of torque characteristics. (*Fig. 2*) This figure gives the comparative torque characteristics of 250 H.P., 1200 R.P.M., 60 Cycle, 2200 Volt Synchronous Motor and Squirrel Cage Induction Motor. The speed torque curve given for the Synchronous Motor can be taken as characteristic of this type of Motor with Squirrel Cage winding of average resistance, or that most common in commercial machines. It will be noted that the initial torque of the Synchronous Motor, exceeds that of the Induction Motor but that the final or "pull in" torque of the Induction Motor, is much better than that of the Synchronous Motor. By using the curves of apparent torque efficiency, we note that for

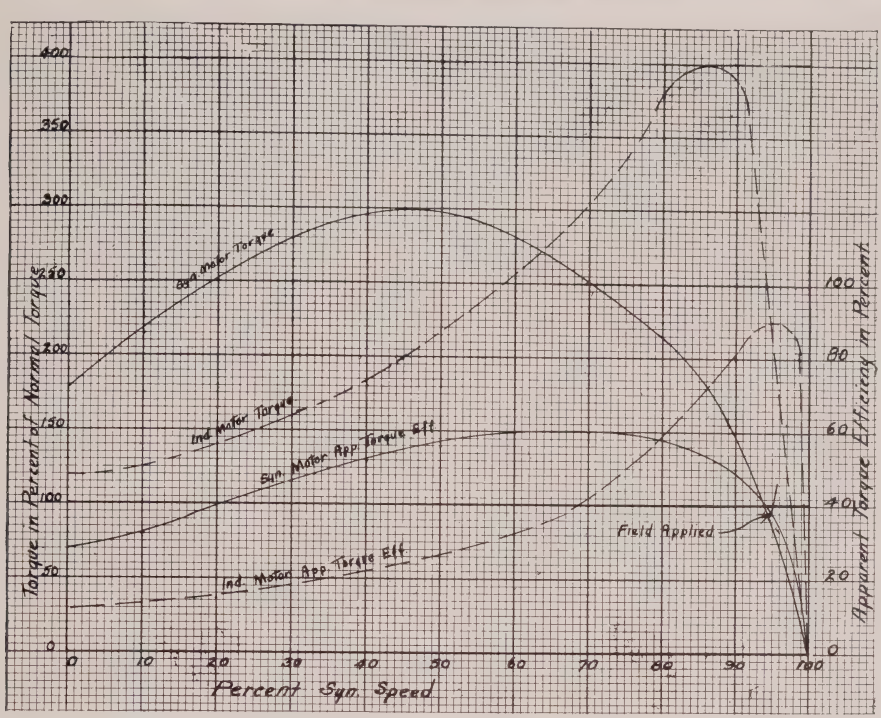


Fig. II

the same input, the torque of the Synchronous Motor is greater up to about 80% of speed. It then falls off rapidly, until at 90% of speed, it is not much more than one-half that of the Induction Motor. Beyond this point the Synchronous Motor torque is small in comparison with the Induction Motor until the D.C. field is excited at about 95% of full speed, when it rises abruptly to full torque.

In view of the foregoing, it is perfectly obvious that either type of Motor has advantages which are peculiar to itself proper consideration of which will enable the engineer to put the right Motor in the right place. It is useful to keep in mind the broad distinction that the Induction Motors are poor and expensive at low speeds while they are exceedingly satisfactory and comparatively cheap at high speeds. Also the greater the capacity of the machine required, the greater the advantage of the Synchronous Motor in relation to first cost. It is evident that for extremely small applications of power the Synchronous apparatus (except in a few isolated cases) has the disadvantage of extremely high first cost and complicated equipment and operation when compared with the Induction Motor.

It may be stated in general that the customer of a Power Company has little technical interest in the use of synchronous equipment, since it is more expensive than Induction Motor equipment, is not readily adapted to extremely small unit installation and is, even with the present design, less rugged and easy to operate. On the other hand, in the larger units, these points are of less significance and industrial application of Synchronous Motors can be made where relatively large concentrated power applications occur. This may sometimes be supplemented by, but is generally differentiated from, group and individual motor drives in a manufacturing plant. It will, therefore, be found that such applications will be made on large centralized equipment, such as air compressors, refrigerating machines, pumps, motor generator sets, etc., or in certain instances where there is one centralized power supply using mechanical distribution through-out the plant. An example of this latter case is the smaller milling concerns, where all the manufacturing processes are correlated and there is no diversity factor since all machines operate at load when the mill is in commission. This particular case gives an opportunity for the commercial application of Synchronous machines more especially so as there is no requirement for frequent starting and stopping which obviously is not advantageous to the Synchronous equipment.

From the standpoint of the consumer of power, the motive for the Synchronous Motor Application is found either in a power rate favourable to unity power factor or leading load, in a sharing of the expense of initial installation by the central station company, or in a special rate lower than that for the Induction Motor service and offered by the central station in consideration of the improvement of distribution conditions which will prove advantageous to the central station company.

Almost all modern systems of charge for electric power are based on the maximum demand in conjunction with the kilowatt-hours usually in the form of a direct charge for power and another direct charge for energy or on a load factor distributed over a period of time In the latter case the charge comes back to either a recorded demand charge or the rating of the connected equipment. Usually a metered system of demand seems to be distinctly preferable.

If such a metered demand were based on the kilovolt amperes rather than on the kilowatts, the consumer has a distinct interest in maintaining the power factor as near to unity as possible. In the case where energy is supplied from a hydroelectric plant, over a long distance transmission line, this is the rule and the customer has an incentive to make Synchronous installation of usually from ten to thirty per cent. of the annual cost of power

When operating companies take account of the power factor of the customer's load in making their rates, it is to the customer's benefit

to install condenser capacity and thus obtain the benefit of decreased power rates, if, by so doing, the saving in power cost will pay the fixed charges on the capital required, as well as the increased operating charges, due to the installation of such an equipment. Another instance of the value of the correction of the power factor alone would be in case the customer owns the step-down transformers and, due to the natural growth of this plant, the Induction Motor load has reached the limit of the transformer capacity. The power factor of the average commercial Induction Motor load is in the neighborhood of 70 per cent. so that by installing a Synchronous Motor, which in addition to delivering mechanical power would also furnish sufficient leading current to raise the power factor of the whole load, the capacity of the plant could be increased by a considerable amount without increasing the transformer or switching equipment. Under these conditions a Synchronous Motor of 35 per cent. of the total transformer capacity will deliver an energy load of 20 per cent. of the total capacity and at the same time raise the power factor of the system to 90 per cent.

The efficiency of a generator is affected by the power factor, although this variation is greatly modified by the ratio of the constant to the variable losses in the machine. This is determined by the design of the generator. There will be a difference of 2 to 2½ per cent., however, in the efficiency of a generator operating at normal load and unity power factor, and the same generator operating at the same kv-a. and 0.8 power factor. The excitation required by a generator when operating at 0.8 power factor will be in the neighborhood of 50 per cent. greater than that required for the same kv-a. at unity power factor. This rate of increase in excitation does not continue for power factors below 80 per cent.

The effects of varying the power factor on transformers, although smaller in magnitude than the effects on the generator, must be considered since they occur twice, at the step-up and at the step-down transformers. The losses in a transformer with constant kv-a. output are practically the same for any power factor. However, since the losses are usually small in a well designed transformer, the decrease in the efficiency, due to decreased power factor, will be about 0.4 per cent. with a reduction in power factor to 0.8.

Due to the fact that transformers contain a certain amount of inductance it is readily seen that lagging current will cause an increase in the internal voltage drop of the transformer and thus will affect the regulation, particularly in the case of large transformers which usually have a high reactance. The capacity of a transformer decreases with the power factor in the same manner as in the generating equipment.

The decrease in efficiency, between unity and 0.8 power factor for constant kv-a. in a circuit,

which includes generator, transformers and the transmission line, assuming average values, will be approximately as follows :

Generator	2 per cent.
Transformers	0.8 per cent.
Transmission Lines	2.2 per cent.

This gives a total of 5.0 per cent. decrease in efficiency. The regulation of the System becomes steadily worse with lower power factors, although the increase varies in different portions of the circuit. This condition results in either greatly increased excitation on the generators or else widely varying voltages at the receiving end of the circuit for varying loads. The capacity of the System for equal heating will be decreased directly with the power factor. This point is modified, however, in the case of the generator fields, which will suffer an increase in temperature with lagging power factors, due to the increased excitation required.

It will be noted that by an investment of a relatively small amount in the condenser, a much larger amount represented by the prime movers, generators, transmission line and transformers, is made available. In addition, the operating efficiency of the entire system is very greatly increased.

An attempt has been made in the foregoing to point out various conditions which make the installation of Synchronous equipment of commercial value. The discussion has been primarily confined to that covering a Synchronous Motor carrying both mechanical load and condenser load. This is, of course, the ideal arrangement as highest efficiency is obtained from the Synchronous machine under these conditions. There is, however, a special application of Synchronous Motors coming under the classification of "Synchronous Condensers" and divided into two main classes of service. First—the regulation of power factor, merely, without mechanical load ; Second the regulation of voltage by means of varying power factors. In the first class of operation, the condenser would probably be installed as a portion of the customer's equipment and would, therefore, probably be removed from the control of the power company. Where a condenser is used, however, for regulating the voltage of a transmission line, the condenser will probably be the property of the owner of the line and will be operated as a part thereof, and moreover will probably be controlled by an automatic voltage regulator.

In the case of the first class for power factor correction only, the Synchronous condenser will only be required to deliver leading current and would cost approximately 15 per cent. less than Synchronous Motor having the same continuous rated capacity.

In the case of the second class for voltage regulation where automatic regulator is used in conjunction with the motor to maintain the voltage constant, the condenser must deliver both leading and lagging current and the cost will be practically the same as a Synchronous Motor of the same capacity.

The installation of the Synchronous equipment is, however, not warranted in every instance and is a matter which should be given every detailed consideration before the installation is proceeded with.

For any such installation which may be under consideration the matter should be brought down to a dollar and cents basis, if possible. The cost of the new apparatus should be balanced against increase in capacity. Increased operating costs should be balanced against increase in efficiency, and a comparison should be made of the service with and without the condenser.

In general a Synchronous condenser will have the most effect and therefore, will be of the greatest value when it is installed at the same point as the load since in this case it benefits all apparatus between itself and the generator. A further gain is obtained by driving a mechanical load in addition to the corrective action of the condenser.

For the average industrial use, it may be taken as a general rule that the Synchronous Motor having equal motor capacity and condenser capacity, is the most efficient and economical. In this case, the motor will carry full rated mechanical load at approximately 71 per cent. power factor.

It would be advisable to consider, for a short time, the general construction of Synchronous Motors. Generally speaking, the construction of the Synchronous Motor is identical with that of the alternating current generator ; the difference between the two lies mainly in the way they are used. The Generator receives mechanical power at its shaft and this is transformed into electrical power, which is delivered from the armature ; the Synchronous Motor operates inversely to this—that is, it receives electrical power through its armature and transforms this into mechanical power which is delivered from the shaft.

The installation of the early type of Synchronous Motor was comparatively complicated ; due to the low starting torque of the motor, it was necessary to employ auxiliary power to bring the unit up to Synchronous speed ; this was usually accomplished by means of an induction motor geared to or mounted directly on the Synchronous Motor shaft. In the modern type of motor, this inconvenience has been eliminated by greatly improving its self-starting characteristics. This is accomplished by means of the auxiliary "squirrel cage" winding in the pole faces similar to the secondary winding of an Induction Motor.

Fig. 3* shows an assembled rotor equipped with such a winding. The copper or brass bars are driven through slots punched in the pole face and short circuited by the circular end rings, into which they are riveted. The action is identical with that which takes place in an induction motor. When voltage is impressed at the armature terminals, a revolving stator flux is set up which induces currents in the short circuited "squirrel cage" winding and these reacting against the armature currents, produce rotation of the revolving element.

* Illustrations omitted due to insufficient time to make engravings.

It is evident that when the rotor is turning at uniform Synchronous speed - that is the "squirrel cage" winding and the armature flux are revolving at the same speed -there will be no differential action and consequently no current will be generated in the secondary winding. Under ideal conditions the "squirrel cage" winding would then be operative only during the period of sub-synchronous speed ; unfortunately, this is not always the case. When operating under fluctuating line conditions, the inertia of the revolving element produces an alternate acceleration and retardation of the poles relative to the armature flux ; this is what is termed "hunting" of the motor and results in a heavy interchange of the current between the motor and line. The "squirrel cage" winding, if properly designed, acts to prevent this trouble as any tendency to acceleration or retardation of the rotor sets up currents in this winding which so react against the armature currents as to damp the period of angular swing.

The "squirrel cage" winding, as usually designed for Synchronous Motor work, must satisfy three different conditions ; (a) the ideal design for high starting torque requires a winding of comparatively high resistance ; (b) for a strong "pull-in torque"—i.e., the torque to draw the motor into Synchronous speed—this resistance should be considerably decreased and (c) for a perfect damper against "hunting" the ideal winding, should have a negligible resistance. The design which will satisfactorily meet all three conditions must, therefore be in the nature of a compromise. Either the starting conditions or the "pulling in" condition is usually the predominating factor which determines the value of the resistance chosen, the relative importance of these factors varying with the nature of the motor load.

An example of this is shown in Fig. 4. At "A" is shown the torque curve for a motor starting a reciprocating air compressor with all

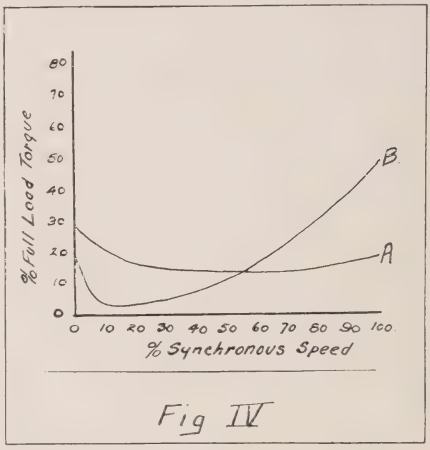


Fig IV

valves open to atmospheric pressure. In this case it required 30 per cent. torque to start the unit and but 20 per cent. torque to pull the motor into Synchronism. At "B", similar results are given for a motor connected to centrifugal pump or to a blower, all valves or shutters being closed. In this case the percentage of "pulling in" torque is over three times that required for starting from rest. It is evident that the relative resistance of the "squirrel cage" winding should be higher in the first case than in the second.

Figure 5* illustrates a different type of rotor construction. In this case the slots break through to the surface of the pole and are deep and narrow. This gives to a certain extent an automatic change in the resistance as the motor speeds up. When at rest the full periodicity causes the current to crowd to the top of the winding and has the same effect as the higher resistance winding, which is the condition desired at the instant of starting. As Synchronism is approached the periodicity of the current in the winding becomes low and the resistance is consequently reduced, bringing about a condition most favourable to "pull-in" torque. There are various other types of rotor construction which need not be discussed here, but it is to be noted, that different conditions of operation call for all these various types of construction.

Figs. 6,* 7* and 8,* illustrate Synchronous Motors which have been built for particular classes of work. Fig. 6 shows a 250 H.P., 3 phase, 60 cycle, 4000 volt, 1200 R.P.M., Synchronous Motor with direct connected exciter for driving centrifugal pump. Fig. 7 illustrates a 150 H.P. Synchronous Motor of the vertical type for direct connection to centrifugal pump. Fig. 8 depicts a 500 H.P., 240 R.P.M., Synchronous Motor with direct connected exciter and flexible coupling for driving a pulp grinder.

The Synchronous Motor has a wide range of application, its principal uses being for driving of line shafting, pumps, air compressions, blowers, direct current generators and alternating current generators of different frequency. There is also a considerable demand for intermediate speed motors for pulp grinding. In practically none of these applications, is the starting condition very severe. In motor generator sets, all that is required is sufficient torque to bring up the motor itself and the generator, which requires, as a rule, about the same torque effort. In the case of motors direct connected to air compressors and pumps, bypasses are generally arranged so that the Synchronous speed is attained before the load is put on. It has been found desirable, in certain pulp grinding motors, to have a very high initial starting torque, since pulp grinders sometimes shut down in such manner as to leave the pockets clogged. Unless the motor is capable of exerting great torque at the instant of starting it becomes necessary to open up the grinder and clean out the pockets.

The calculation of the capacity of a Synchronous Motor for any given service is not highly technical or extremely difficult. Nevertheless, if the problem is handled mechanically very tedious work is involved on account of the frequent occurrence of the square root in solving the problem. If the problem is solved graphically, the work involved is very small and the result is satisfactory for most ordinary cases. In fig. 9 is shown a chart which will enable the solution to be obtained graphically. As will be noted this chart gives the relation between kilowatts and

* Illustrations omitted due to insufficient time to make engravings.

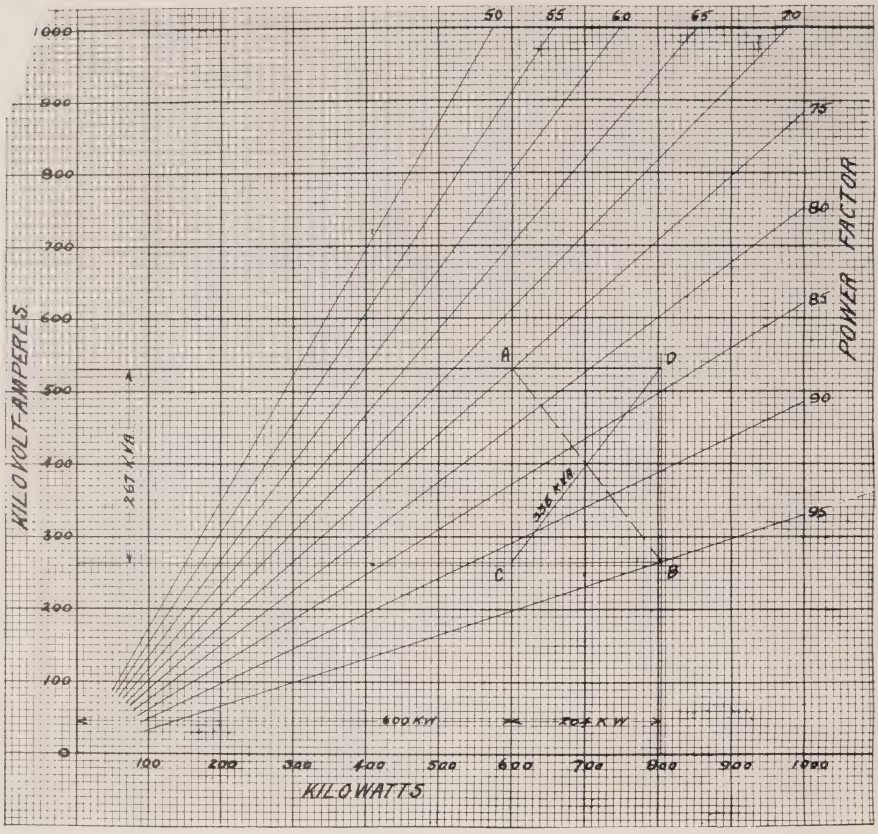


Fig. IX

wattless K.V.A. and total K.V.A. for any power factor from 95 to 50 per cent. If we suppose that we have a load of 600 K.W. at 75 per cent. power factor and that a Synchronous Motor is to be installed which will carry a mechanical load of 275 H.P. and correct the power factor of the circuit to 95 per cent. then by obtaining the point "A" on the 75 per cent. power factor line corresponding to 600 K.W. and the point "B" on the 95 per cent. power factor line corresponding to the total kilowatts with the Synchronous Motor in operation (804 K.W.), the capacity of the Synchronous Motor required is given in K.V.A. by the distance "AB" measured on the same scale as the rest of the diagram. In this case a 336 K.V.A. motor would be required.

The foregoing is merely an attempt to collect together certain facts with regard to Synchronous Motors and to place these facts in their proper relation with the commercial use of this particular type of apparatus. It is hoped that

these points have been of some interest and that some of them may be used by the reader at a later date.

Discussion

The President: Mr. McHenry is to be complimented on the paper he has presented. It is necessarily of somewhat a technical nature but he has given it in such simple and explicit language that there has been no difficulty in following what it contains.

Mr. Lee, Toronto: I can hardly agree with Mr. McHenry as to the advantages of the synchronous motor. It appears to me that it is like a man having an ailment and the doctor prescribes a medicine and as long as he has the medicine he is relieved and feels well, but what will happen when he has no more medicine. If in a large factory operating with a very poor power factor and they were to install a synchronous motor, and the synchronous motor fails, we have the same condition as we had before the installation of the synchronous motor. The poor power factor is something the municipalities have to take into consideration. On account of conserving the supply of electrical energy for the manufacture of munitions the case of poor power factor is to a great extent ignored in getting manufacturers to install motors. He uses his own judgment and the result is he installs a motor of greater capacity than he requires. In days gone by when the supply was greater it was perhaps not necessary to install motors of a capacity to meet the supply. I think that while the synchronous motor to a certain extent helps the impediment of poor power factor, the municipalities should get together and force all manufacturers before they install motors to get into touch with the municipalities and have them specify and recommend proper motors to meet the requirements of the situation. We all know that it is not hard to sell motors. I never yet found where a man buys a five H.P. motor and several months later requires a 10 H.P. that he cannot sell and get a small discount on his motor and then purchase a motor of suitable capacity to meet his increased needs, in this way he will be obtaining maximum efficiency and at the same time aid the central station in maintaining the high power factor on the system.

Mr. Lines: The question is what do engineers really want? Do they want Kilovoltamperes or kilo watts? I think engineers would rather have the K. V. A. meter. If we can get any information on that it would be very gratifying in our development work.

Mr. Ireland: I think there is very little doubt that in the very near future all power contractors are going to measure all demands not on the kilo watt basis but on the K. V. A. As a matter of fact it is a matter of taking chances on two stops rather than one. I would like to state one instance of short-sightedness. The case of a large industry running between four and five thousand horsepower. Naturally their bills were high. They objected to the bills and it was shown that they were large for the sole

reason that the power factor was low. They were advised to put in a second hand A. C. Generator as a synchronous condenser which they did not do. They would have got back their investment in 11 months if they had done so. The distributing company installed this generator in its own substation to correct this load, and took the advantage that which this manufacturer refused.

Mr. Sifton: I think it a good thing to watch the manufacturer to a certain extent when you know there is going to be a contract and a motor is going to be bought. Give them advice and get them to buy in the right way. I know we have had good results. In one case they had the wrong engine and they got in too large a sized motor. They did not see fit to change it. The matter was taken up and argued and re-argued that the load would be taken care of better by a motor that was not too large. I certainly would like to see the representatives of the Hydro-Electric Power Commission, if there are any on the ground, take up the question with the municipalities and go into the question of penalizing bad and bonusing good power factors.

The President: The Hydro-Electric Commission penalizes municipalities when the power factor is not maintained at 90 per cent., but there is no question of bonusing if you boost it up. I think it is a poor rule that does not work both ways. I know in London we have had various requests to keep our power factor up. We have never received any discount on our bill and immediately we fall to 89.6 power factor we are penalized.

Mr. Yates: I differ from Mr. Sifton. Naturally when we talk of penalty we begin to think of getting into trouble. You never can make a man think he is being put in gaol because he rightly deserves being put there and make him see the justice of it. If you put a kilo volt ampere meter on and charge a man accordingly he does not know anything about it and he is getting exactly what he wants.

Mr. Kribs: The K. V. A. is what he uses and our generator and transformers have to be built on an average for K. V. A. jobs. I think if you put him on a straight business-like basis and keep off the penalty, you get the best results.

Mr. Lines: What about the present time. Municipalities are being penalized for poor power factors and they have no remedy. Why not have the customers do the proper thing by reducing their motor power or installing motor power to their requirements.

Mr. Heeg: We are peculiarly situated in Guelph and we are not using them for Hydro operation only. My orders were, in the event of overload, that we must use synchronous motors. We can have everything there in the way of power but we must have the synchronous motor in case of overload. I think the Hydro Commission is giving credit for what we do in the way of bonus. In our case where we have a thousand K. V. A. we can do some work and I think we are deserving of some consideration.

The President: I am glad there is so much discussion forthcoming, but I am afraid the time is getting on.

Mr. McHenry: There is just one point which occurs to me and that is the fact that it is not necessary to install a synchronous motor for power factor maintenance in every case. The installation should be very carefully looked after before it is gone ahead with. The point that I wished to bring out is the fact that a great deal of work can be done by the municipalities where the users maintain a high power factor in enough plants. They can work things out on the basis of higher efficiency and least possible cost of production. There are still plants that are running in a sort of haphazard manner and install motors that are capable of carrying large amounts at full load but possible for only half an hour a day and consequently the power factor is low. In that case we usually give a little information and advise them that i a lower capacity is installed, it would run very nearly at full load continually. A lot can be done this way in a sort of missionary manner by taking it up with large power consumers.

Moved by Mr. Scott, seconded by Mr. Lyons, that a hearty vote of thanks be tendered Mr. McHenry for his paper. Carried.

Mr. H. G. Acres gave a short talk descriptive of the Chippewa Development.

Moved by Mr. V. S. McIntyre and seconded by Mr. Oswald H. Scott.

That Mr. H. F. Shearer be elected member of the Papers Committee, replacing Mr. H. D. Rothwell, who had entered the Canadian Engineers. Carried.

Moved by Mr. J. E. B. Phelps and seconded by Mr. P. B. Yates:

That the fixing of the time and place of the next general meeting of the Association be left to the Executive Committee. Carried.

The meeting adjourned at 12.30 o'clock.

Afternoon, 2.00 o'clock.

The Association became the guests of the Hydro-Electric Power Commission of Ontario, when a tour was made of the site and works of the Chippewa development.

The following were present:

Municipal Delegates

Belleville	Oswald H. Scott
Bowmanville	G. E. Chase
Brampton	Geo. Ostrander, John Shiers
Brantford	W. P. Catton, Andrew McFarland
Brighton	Royal Quick
Campbellford	W. S. Russell
Cannington	J. E. Cornfoot
Chatham	J. G. Jackson, Chas. E. Clements Mayor
Clinton	H. B. Chant
Cobourg	J. E. Skidmore
Collingwood	E. J. Stapleton, W. B. H. Patton (Mayor) S. Burnside.
Dresden	Chas. Eberlee
Dundas	Geo. E. Whiton
Galt	R. Elliott
Gravenhurst	V. F. Hunt
Guelph	John J. Hegg, M. W. Wheeler

Hamilton.....E. I. Sifton, W. H. Childs
Hespeler.....M. E. Jardine, W. D. Scott
Ingersoll.....H. G. Hall
Kenora.....S. A. Saylor
Kitchener....V. S. McIntyre, Geo. Lippert
Kingston.....E. J. Hartrick
Leamington...C. J. DeBats
Lindsay.....W. E. Reesor
London.....E. V. Buchanan, A. O. Hunt, G. W. Blay
Merritton....W. R. Savigny, Jas. Rennie
Midland.....S. J. Milliken
Milverton....A. C. Clemens, J. C. Grosch
Mimico.....Thos. E. Bell, Geo. Stubbs.
Napanee.....Chas. A. Walters
New Hamburg Geo. Morley
New Toronto. J. W. Cook
Niagara Falls.J. W. Bayliss, G. E. Foster
Norwich.....W. Daykin
Oshawa.....A. T. Hicks
Owen Sound..J. R. McLinden, A. F. Armstrong
Peterboro....H. O. Fisk
Petrolia.....G. W. Currie
Port Hope....V. B. Coleman
Preston.....C. S. MacKenzie
Sarnia.....J. E. B. Phelps
Smith's Falls..H. F. Shearer, Geo. B. Frost
St. Catharines.P. B. Yates, F. M. Servos
St. Jacobs....E. A. Burges, F. E. Wilken, I. B. Burbacher
St. Thomas...E. H. Caughell, J. J. Roberts
Stratford.....R. H. Myers
Strathroy.....E. R. Smithrin
Tillsonburg...J. E. Teckoe
Sudbury.....R. H. Martindale
Toronto.....H. H. Couzens, R. G. Lee, W. C. Burch, C. E. Schwenger, A. W. J. Stewart, J. B. Kitchen, C.W. Fatt E. M. Ashworth, Wm. F. Kelly
Trenton.....F. C. Adsett
Walkerville...M. J. McHenry
Waterford....J. R. Forbes, T. C. Savage
Waterloo.....Geo. Grosz
Welland.....H. E. Timmerman
Weston.....A. G. Pierson, F. G. Cousins
Windsor.....O. M. Perry
Whitby.....W. J. McIntyre
Woodstock...J. G. Archibald

O.M.E.A. Delegates

W. K. Sanderson, St. Thomas; W. Ellis, Hamilton.

Associates

F. A. Gaby, J. S. Parker, S. L. Eisenhoffer, Gordon Kribs, G. F. Drewry G. J. Mickler, R. M. Bond, E. R. Lawler, A. G. Lang, J. N. Wilson, J. H. Caster, J. J. Jeffery, L. G. Ireland, S. R. A. Clement, R. C. McCollum, H. J. Surtees, F. T. Stocking, J. F. S. Madden, W. M. Bostwick, Wills

Maclachlan, W. H. Mulligan, K. R. McClellan, E. T. Brandon, B. O. Salter, H. C. Don Carlos, H. F. Strickland, W. P. Dobson, H.E.P.C. of Ontario Office.

Visitors

S. L. B. Lines, Chamberlain & Hookham Co., J. A. Shand, J. F. Hill, W. H. Christie, H. A. Burson, Canadian Crocker-Wheeler Co.; J. W. R. Taylor, A. C. Johnston, W. M. Andrew, Canadian Westinghouse Co., W. R. Greenshields, Canadian Wire & Cable Co., H. E. Hunter, F. A. Mahoney, C. H. Beavis, A. S. McCordick, B. F. Selby, Wm. A. Bucke, A. G. Cooper, W. G. Young, Canadian General Electric Co., W. S. Ewens, H. J. Hammond, Northern Electric Co., R. H. Starr, Geo. D. Leacock, Moloney Electric Co., C. C. Bothwell, Laco Philips Co., Geo. C. Rough, Packard Electric Co., H. H. Madgsick, National Lamp Works of The General Electric Co., Cleveland, Ohio, Fred. W. Field, H. M. Trade, Commissioner, H. G. Acres, Hydraulic Engineer, H.E.P.C. S. L. Weber, St. Jacobs, S. Stroud, Hamilton, C. N. Farrow, J. J. O'Hearn, Toronto, L. M. Bradley, St. Thomas, K. M. Sorrich, Chatham, C. V. Edmonds, V. K. Stalford, Geo. W. Howse, A. T. Smith, Wiring Inspectors H.E.P.C.

President's Address

IT is very fitting that the first convention of the Association of Municipal Electrical Engineers should meet in Niagara Falls, where six million horsepower awaits development. I don't think any group of electrical men on the globe have such a great heritage to come into as we have in Ontario. Not only have we Niagara Falls, but we have other streams capable of large developments and in a country where we have a splendid climate and situated as we are in every way for industrial development because of our location with respect to the great markets of the world, we have much for which to be thankful. We have to be thankful also that we have a man of such resourcefulness as Sir Adam Beck to follow in his great hydro-electrical project.

We will hear in a little while the reports of the secretary and the treasurer and these reports will show you that this Association is making progress. You will notice when these reports are being given that some of our neighboring municipalities are not represented. I hope you will do some recruiting work when you get home and see that these municipalities come in. We have also to consider some

amendments to the constitution and By-laws and you are asked to give your consideration to these.

Nowadays we hear much talk of conservation, efficiency in production and efficiency in use. Conservation is a word which was not very much used until recently; the practice of it even less. Now however, when seen at such close range it presents many new restraints. All the papers that are to be presented here to-day will be in some way or other connected with conservation. How we can do things better in less time, with less labor or with less money. Take for example the paper on synchronous motors; that will show us how to eliminate or how to reduce what we call watt-less current. Then the paper on factory lighting; that will tell us of economy in lighting. It is not a matter of how little light we can get along with, but how much light we can supply advantageously to produce better results. The other papers are concerned with the same thing. They all have reference to the saving of property, the saving or man power and so on. To-morrow morning Mr. Acres will give us a talk on the Chippewa development. It is fortunate that we should be here at the initial stage of this development. When we come back for another visit which will be in a year perhaps, we will understand and appreciate the progress which has been made.

On behalf of the Association I welcome the representatives of the municipal districts and visitors that are with us to-day.

Secretary's Report

OUR efforts since organization have been confined chiefly to obtaining membership for the Association. A list was first prepared of all the municipalities in Ontario having municiaplly owned electric utilities. A form letter was drawn up and addressed to the various Chairmen of the municipal Commissions or Committees of Council controlling those utilities. This letter advised of the formation of the Association and the desirability of becoming members. Immediately following this a second letter was sent out to the Managers, Superintendents, and Secretaries, one letter to each Municipality asking for their co-operation. This second letter was accompanied by a form of application for membership and a copy of the Constitution and By-laws, 189 Municipalities were approached in this manner.

The Chairman of the Membership and Credentials Committee was supplied with a list of these Municipalities for the assistance of the Committee in obtaining members. To date 64 of these Municipalities

have become members of the Association and paid their dues. Two Municipalities have advised that they did not see their way clear to come into the Association at this time. The Chairman of the Membership and Credentials' Committee was advised of the fact so that he could take steps to have them reconsider their decision. The remaining Municipalities have made no reply.

In addition to these, there are 19 Municipalities whose systems are owned and operated as under the Hydro-Electric Power Commission of Ontario whose membership has been paid by the Commission.

All told, the Association has 83 member Municipalities, being as follows:—

Independent Municipalities.

Campbellford, Kenora, Merritton, Stirling, Sudbury, and Whitby, (6).

Hydro supplied.

Beaverton, Brampton, Brantford, Brockville, Chatham, Clinton, Collingwood, Dresden, Dundas, Dutton, Fergus, Galt, Georgetown, Gravenhurst, Guelph, Hamilton, Harriston, Hensall, Ingersoll, Kitchener, London, Midland, Milverton, Mimico, New Hamburg, New Toronto, Niagara Falls, Norwich, Orangeville, Ottawa, Owen Sound, Penetang, Peterboro, Port Colborne, Port Credit, Port Dalhousie, Port Stanley, Preston, Rockwood, Sarnia, Seaforth, Smith's Falls, St. Catharines, St. Jacobs, St. Thomas, Stratford, Strathroy, Sunderland, Tillsonburg, Toronto, Toronto Township, Walkerville, Waterloo, Welland, Winchester, Windsor, Woodstock, Woodville, (58).

Hydro operated.

Belleville, Bowmanville, Brighton, Calander, Cobourg, Deseronto, Lindsay, Millbrook, Napanee, Newburg, Newcastle, Nipissing, North Bay, Orona, Oshawa, Port Hope, Powassan, Trenton, Tweed, (19).

It has been suggested that the Association have some insignia for use on our letter heads and possibly in the form of a button, I therefore caused an advertisement to be placed in the May issue of the Bulletin asking for suggestions. This has brought forth four replies. It is suggested that the Association name a Committee to consider these, and to make any recommendations it may think proper.

Treasurer's Report

AS the details regarding membership in the Association have already been given by the Secretary, I will confine my report to a summary of the total receipts, grouping only the total for each fee provided in the Constitution with a detailed record of the disbursements, as follows:

JUNE 12th, 1918

Number of Municipalities taking membership:—

4 at $50.00	=	$200.00
5 at 25.00	=	125.00
9 at 15.00	=	135.00

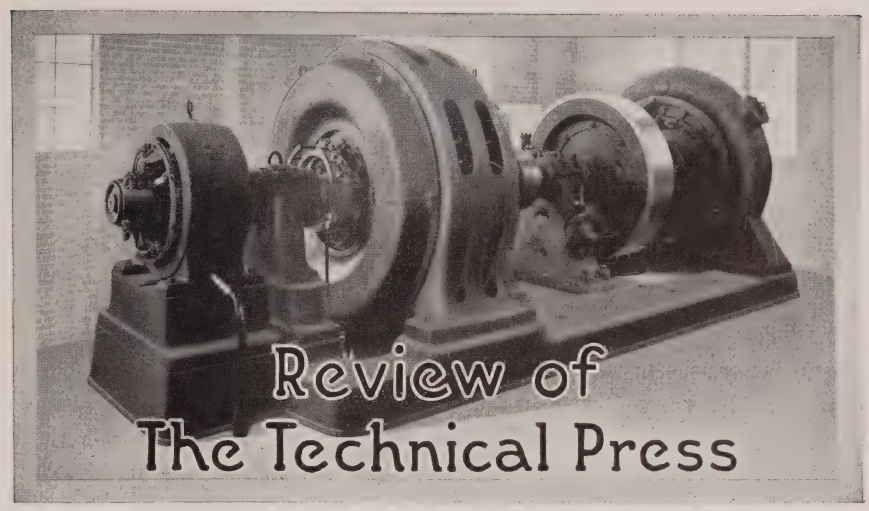
13 at	10.00	=	130.00
13 at	7.50	=	97.50
19 at	5.00	=	95.00
20 at	2.00	=	40.00
83	Total		$822.50 $822.50

DISBURSEMENTS

Music for last general meeting	$33.00
Grand & Toy for record books	5.15
United Typewriter Company Form letters	12.69
Strathmore Press—Printing	27.70
E. V. Buchanan—Expenses to executive meeting	8.85
Postage	13.59
H.E.P.C. meals for members of executive—	8.00
Ambrose Kent & Sons—Convention badges	10.00
ExchangeonCheques	5.50
	$124.48 $124.48
Balance cash on hand	$698.02

Household Labor Savers

THE need for labor saving in the home, both because of the shortage of domestic help and because of the entrance of so many housewives into Red Cross and similar activities, greatly enlarges the field for washing and ironing machines, dishwashers, vacuum cleaners, and other motor-driven appliances for household tasks. Such appliances should receive the attention of the municipalities at this season. They are not only profitable themselves but serve as an argument for housewiring, and carry in their train, sales of multiple plugs, wiring of added receptacles, and sales of Hydro Quality lamps for saving, on lighting, the current used by the motors.



Ground Connections for Distribution Systems

SINCE information in connection with the grounding of secondaries will probably assist in work of this nature in Ontario, we draw attention to an article on the subject by W. C. Heston, appearing in the March 1st issue of the *Journal of Electricity*.

This deals with the experiments of the Portland Railway, Light & Power Company, in their efforts to comply with the rulings of the Public Service Commission. It would seem that this Commission required the installation of a 1/16" copper plate having an area of not less than 3 feet by 6 feet and buried in coke below the permanent moisture level. It is possibly not necessary to explain that the results obtained in Portland would necessarily apply only to their own conditions, there being of course different conditions of ground and moisture from place to place.

One experiment was made using a ¾-inch galvanized iron pipe driven into the ground to a depth of 6 feet, 600 volt D.C. railway current was used with ammeter and volt meter readings taken at one minute intervals. At the start a resistance of 85.7 ohms. was recorded and at the end of 8 minutes the resistance had risen quite steadily and rapidly to 240 ohms. The ground was said to be comparatively free from gravel and rocks and the weather had been rainy for a week prior, hence this type of ground was tested under favorable conditions. Due to the fact however that the voltage measurements were made to an adjoining railway track, the results are not a true gauge of the ground resistance since they include resistance from the rails to the earth and the street car rails themselves. The conclusion

is, however, that the resistance of the pipe itself is more than one-half of the resistance recorded.

Other tests were made by a different method in an effort to determine the resistance of the pipe alone, and this test showed a resistance of 30.4 ohms. The results show however, a rapid rise in resistance due to the drying out of the earth around the pipe when current is flowing.

Another test was made using a tinned copper plate 3 feet by 6 feet in accordance with the Commission's specifications. This plate was placed horizontally in the ground at a depth of 6 feet with 3 inches of coke on either side. A test was made using 600 volt railway current and the resistance at the start was found to be 14.65 ohms. Frequent readings up to thirty minutes were continued and it was found that the resistance was practically constant rising only to slightly over 15 ohms. These tests were made the day after the plate was installed when about 30 gallons of water was poured into the hole, hence the test was made under favorable conditions. The resistances given include, as in the first case quoted, the street car rails in series with the plate. This plate was installed in the spring of 1915 and in order to ascertain whether any appreciable change took place the test was repeated on the last of August, 1915, when it was found that the resistance had decreased about 2 ohms. during the time the plate was installed, despite the fact that the weather was dry during most of the intervening period.

A third test was made on the same plate early in October, 1916 when a resistance of 9.1 ohms. was obtained with a current of 65 amperes showing a marked decrease in resistance with time. It was concluded from this that the permanence and effectiveness of this type of grounding are all that can be desired, but the high cost of installation makes it prohibitive except in special cases. The cost of installation at the time was $41.00 and would be considerably increased under present conditions.

Since neither of the two former types of grounds seem practical, one on the score of too high resistance, and the other on the score of too high cost, a further experiment was made by using a ¾-inch galvanized iron pipe driven to a depth of 18 feet in very gravelly soil. At a depth of 9 feet a current of 3 amperes at 575 volts was found to flow. Current was applied at various depths but did not increase above 3 amperes during driving process. About 3½ pounds of rock salt was then placed around the pipe and thoroughly soaked into the ground with water. This brought the current up to 10 amperes which seemed to be about the maximum which could be obtained. The resistance of the ground was 192 ohms, before the salt and water were added and 57.5, ohms afterwards, showing that permanent moisture was not reached at a depth of 18 feet.

Another test at a different point was made with readings taken from 9 feet to 18 feet with untreated ground. The resistance ranged

from 119 ohms. at 9 feet to 94.4 ohms. at 18 feet.

Another test was made in a different district with a pipe driven to a depth of 12 feet in clay soil. This one inch galvanized pipe was perforated with about three hundred quarter-inch holes making a sort of sieve. After driving, the pipe was filled with salt and water was poured through to dissolve it. This was repeated several times, but it was found that the salt dissolved very rapidly and would not remain in the pipe for any length of time after installation. Readings taken on this pipe showed 7.5 amperes at 240 volts giving a resistance of 32 ohms. This was before the salt was added. After the addition of about 5 pounds of salt and wetting down, a resistance of 13.75. ohms was obtained.

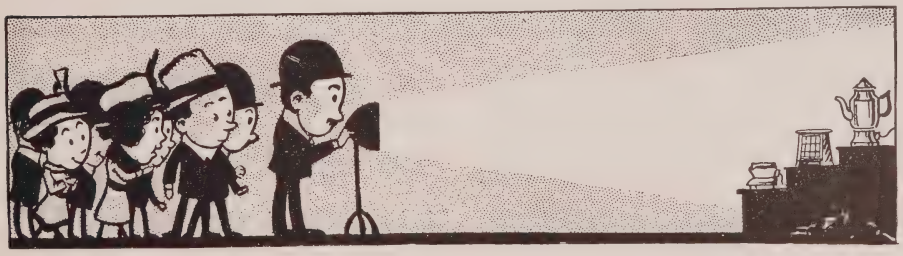
Another test was made with 1-inch pipe driven to a depth of 18½ feet, and distant about 240 feet from the last mentioned experiment. Resistances varied from 31.9 ohms. at 9 feet to 20.95 ohms. at 18½ feet; the 12-inch pipe mentioned just previously was again tested after eight days and showed a decrease of only 1.55 ohms., its resistance with salt being at the end of this time 12.2 ohms.

The conclusions reached from the series of experiments were that where soil conditions are favorable, that is a clay soil free from rocks and gravel a 1-inch galvanized iron pipe driven to 18 feet will provide a satisfactory ground.

Where the soil is gravelly and rocky the only means of obtaining a satisfactory ground is to instal a plate laid in coke, but in order to make this type of ground economically possible it would have to serve as a ground for several transformers connected to a common ground bus.

Apparently the author has not considered the grounding of secondaries to water pipes which were possibly absent in the district considered. It is well recognized however, that carefully made water pipe grounds are the most satisfactory and reliable and that the damage to the water system is nil.

Eighteen foot driven pipe grounds hardly appear practicable to us, and it would be interesting to know how it is done.



Who's Who in Hydro?

OLIVER Mowat Perry, Secretary and Manager of the Windsor Hydro-Electric System, was born February 14th, 1885, at Cloine, Ont.

O. M. Perry

He attended the Public and High Schools at Perth, Ont., and in 1905 entered Queen's University, Kingston, Ontario. from which he graduated with B.S.C. in Electrical Engineering.

Mr. Perry was later employed by The Toronto Electric Light Company, Ltd., in its Engineering Department, where he remained for one and a half years, later going with Smith, Kerry & Chase on the Central Ontario System.

After 3 years Mr. Perry went to Windsor and installed the Hydro-Electric System, assuming the position of Manager on its completion in 1914.

In 1916, Mr. Perry was married to Bessie Shepherd, youngest daughter of Mr. and Mrs. J. H. Shepherd, of Windsor.

Exit Espenschied

THE large attendance at Niagara Falls was the cause of much gratification to the members of the various committees who had worked hard to ensure a big success for the First Convention of the A.M.E.E. Nearly everybody was on hand but at least one was missed who has always been ready at former meetings to take part in the discussions and who took an active part in the preliminary steps which resulted in the formation of the new Association. We refer to F. F. Espenschied, whose resignation from the Engineering Staff of the Commission we regret to report.

In the course of his work during the past seven years Mr. Espenschied came in contact with many of the municipal officials and made many friends, to whom a few details of his career will be of interest.

According to his own statements he was born in St. Louis many years ago—sometime later he at-

tended Missouri University and was graduated from Cornell University in 1905. Immediately thereafter he entered the employ of the West Penn. Railway Company at Pittsburgh where he continued until 1910 when he was appointed General Manager of the Interstate Light and Power Company at Galena, Ill. In 1911 he joined the staff of the Hydro Electric Power Commission.

Mr. Espenschied is now Assistant Chief Engineer of the Combustion Engineering Corporation, 11 Broadway, New York City. This company is the largest manufacturer in America of mechanical stokers and furnaces, and no doubt will provide a wide field and one well suited to Mr. Espenschied's training, ability and temperament.

His friends wish him every success in his new venture and are confident that he will make good. A few days before his departure a number of the Engineering Staff tendered a farewell supper and a gift in remembrance of his associations during the past seven years.

Good Luck! Dutch

By J. F. S. MADDEN

ALL anthracite coal requirements for Central Ontario have been materially reduced, owing to the remarkable success of the range campaign recently conducted at Lindsay, Napanee, Deseronto, Bowmanville and Newcastle on the Central Ontario System. L. G. Ireland states that reports received from W. E. Reesor, C. A. Walters and G. E. Chase indicates that between forty and fifty ranges have been disposed of during the two weeks' campaign. A number of excellent prospects have also been secured and it is expected that many more

ranges will be sold within the next few weeks as a direct result of the campaign.

The campaign was announced by means of local newspaper advertising for several days in advance of the opening date, and effective circular letters mailed to carefully selected mailing lists. Newspaper advertising was continued daily throughout the campaign. The above outline of procedure indicates that these special sales were conducted on the usual plan, but special features were introducted. For example, at Napanee a window display was arranged, showing a turkey, chickens, pies and cakes, all cooked on an "E-30" range. Mr. Walters donated the turkey to the Red Cross Society, to be disposed of by the sale of tickets, which netted the Red Cross the sum of $23.25. This method of advertising created considerable interest in the campaign and with good results, which were due in no small measure to the proficiency of Mrs. Walters, who demonstrated the range most effectively, as many who sampled her cakes will testify.

It is estimated that one hundred and fifty tons of coal will be saved annually as a result of this range campaign. It is interesting to compute the coal saving produced by the electric ranges already in service throughout the Province and to be sold during the coming Fall.

Municipalities on the Niagara System, owing to the power shortage unfortunately are not in a position to force sales on ranges and heating appliances, but in all municipalities where an additional load can be accepted the connecting up of range customers is worthy of the best effort.

We would be glad to hear from any municipality contemplating a campaign to stimulate range sales, and assistance will be gladly furnished on request.

We are reproducing in this issue an advertisement run in the Toronto newspapers by the Toronto Hydro-Electric System, which should be of interest, particularly to municipalities on the Niagara System. The local managers probably feel it their duty not only to sell power, but to conserve the power resources available. This advertisement is based on the fact that better lighting can be obtained at lower power consumption by the more extended use of the gas-filled lamp for commercial lighting, and may suggest other ideas for increasing the application of the gas-filled lamp or presenting its advantages effectively to possible users.

The opening of the new Hydro Shop at Windsor is announced for July 2nd, and the London Public Utilities Commission will open its new store on July 10th. Both municipalities are to be congratulated, and we trust that the improved sales facilities will bring results beyond their best expectations.

Motors and meters have advanced in price recently and without notice. We anticipate an advance in the price of ranges, lamps and other appliances in the near future.

Power Controller's Order

for lighting purposes, "an allowance of one watt per square foot shall be the maximum —see text below—which means fewer lamps and less current consumption — but not necessarily inferior illumination if you will use better lamps.

The Toronto Hydro-Electric System prints herewith the Power Controller's rules with regard to current used for lighting purposes, these rules having been put into effect in order to assist in saving electric current for the production of war supplies.

As a means of making the most effective use of the limited amount of current available under these rules we desire to point out to our customers—and particularly to storekeepers, warehousemen, manufacturers, etc.—that there are many instances in which Hydro Shop's "gas-filled" lamps can be used in place of Tungstens to give the same illumination, with a lower current consumption and using fewer lamps.

Power Controller's Order of May 1st, 1918,—Re Commercial Lighting.

We are requested to draw the attention of consumers to the following :—

With a view to uniformity of interpretation of the Power Controller's order under date of May 1st, the following rules shall apply to the fourth paragraph of the said order:

1. An allowance of one watt per square foot of floor area shall be the maximum, except where extraordinary conditions warrant an individual reference for a special ruling.
2. Area on which allowance is based shall be the net floor area.
3. Wattage employed shall be considered to be the total wattage rating of all lamps actually installed at any time.
4. Every separate room shall be computed separately.
5. These rules apply to all electric lighting, whether from service companies or private plants.
6. All previous rulings of the Power Controller shall remain in full force, and are not affected by these present regulations in any way.

Hydro Shop's "gas-filled" lamps give a whiter light, the special filament allowing the light to be distributed better by reflectors. They have been shown, under test, to give about 25 per cent. more light than Tungstens with the same current, and with just as long a life.

Will you kindly drop in and let us give you further information, or, telephone us and our representative will gladly call and explain Hydro "gas-filled" lamps to you.

Toronto Hydro Shop

226 Yonge St.
Phone Adel. 2120.

Branch, Gerrard & Carlaw,
Phone Gerrard 761.

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HYDRO MUNICIPALITIES

NIAGARA SYSTEM

25 Cycles

	Pop.
Acton	1,735
Ailsa Craig	586
Ayr	800
Baden	710
Beachville	503
Blenheim	1,424
Bolton	727
Bothwell	703
Brampton	4,041
Brantford	25,420
Breslau	500
Brigden	400
Burford	700
Burgessville	300
Caledonia	1,217
Chatham	12,863
Clinton	2,177
Comber	800
Dashwood	350
Delaware	350
Dorchester	400
Dresden	1,521
Drumbo	400
Dublin	218
Dundas	4,652
Dutton	870
Elmire	2,270
Elora	1,115
Embro	483
Etobicoke Township	5,711
Exeter	1,572
Fergus	1,776
Forest	1,495
Galt	11,852
Georgetown	1,905
Goderich	4,655
Grantham Township	3,271
Granton	300
Guelph	16,735
Hagersville	1,105
Hamilton	100,461
Harriston	1,404
Hensall	749
Hespeler	2,740
Highgate	500
Ingersoll	5,176
Kitchener	19,266
Lambeth	350
Listowel	2,326
London	58,055
Lucan	662
Lynden	662
Milton	2,072
Milverton	893
Mimico	1,976
Mitchell	1,687
Mount Brydges	500
New Hamburg	1,543
New Toronto	1,186
Niagara Falls	11,147
Norwich	1,189
Oil Springs	599
Otterville	500
Palmerston	1,843
Paris	4,370
Petrolia	3,891
Plattsville	550
Point Edward	899
Port Credit	1,046
Port Dalhousie	1,318
Port Stanley	849
Preston	4,643
Princeton	600
Ridgetown	2,326
Rockwood	650
Rodney	655
Sandwich	3,077
Sarnia	11,676
Seaforth	1,964
Simcoe	4,061
Springfield	442
St Catharines	17,880
St. George	600
St. Jacobs	400
St. Mary's	3,958
St. Thomas	17,174
Stamford Township	3,418
Stratford	17,081
Strathroy	2,998
Streetsville	539
Tavistock	1,009
Thamesford	504
Thamesville	769
Thorndale	250
Tilbury	1,740
Tillsonburg	3,084
Toronto	463,705
Toronto Township	4,875
Vaughan Township	4,187
Walkerville	5,096
Wallaceburg	4,107
Waterdown	785
Waterford	1,133
Waterloo	4,956
Waterloo Township	6,693
Watford	1,221
Welland	7,243
West Lorne	724
Wellesley	583
Weston	2,156
Windsor	24,162
Woodbridge	639
Woodstock	10,084
Wyoming	544
Zurich	450
Total	993,862

SEVERN SYSTEM

60 Cycles

Barrie	6,453
Camp Borden	.....
Coldwater	579
Collingwood	7,610
Creemore	585
Elmvale	775
Midland	6,258
Orillia	7,448
Penetang	3,928
Port McNichol	500
Stayner	972
Victoria Harbor	1,477
Waubaushene	600
Total	37,185

WASDELL'S SYSTEM

60 Cycles

Beaverton	1,015
Brechin	215
Cannington	903
Sunderland	570
Woodville	388
Total	3,091

ST. LAWRENCE SYSTEM

60 Cycles

Brockville	9,428
Chesterville	854
Prescott	2,740
Williamsburg	100
Winchester	1,065
Total	14,187

EUGENIA SYSTEM

60 Cycles

	Pop.
Alton	700
Artemesia Township	...
Arthur	1,041
Chatsworth	374
Chesley	1,975
Dundalk	721
Durham	1,600
Elmwood	500
Flesherton	428
Grand Valley	644
Hanover	3,221
Holstein	285
Horning's Mills	350
Markdale	989
Mount Forest	1,941
Orangeville	2,493
Owen Sound	11,910
Shelburne	1,115
Tara	590
Total	30,877

OTTAWA SYSTEM

60 Cycles

Ottawa	100,163

PORT ARTHUR SYSTEM

60 Cycles

Port Arthur	14,307

MUSKOKA SYSTEM

60 Cycles

Gravenhurst	1,702
Huntsville	2,395
Total	4,097

CENTRAL ONTARIO SYSTEM

60 Cycles

Belleville	12,277
Bowmanville	3,655
Brighton	1,337
Cobourg	4,712
Colborne	1,012
Deseronto	2,221
Kingston	21,325
Lindsay	7,481
Madoc	1,179
Millbrook	835
Napanee	2,926
Newburgh	486
Newcastle	611
Omemee	482
Orono	700
Oshawa	8,240
Peterboro	20,426
Port Hope	4,649
Stirling	732
Trenton	5,000
Tweed	1,364
Whitby	2,864
Total	104,514

NIPISSING SYSTEM

60 Cycles

Callander	650
Nipissing	400
North Bay	9,855
Powassan	575
Total	11,480

RIDEAU SYSTEM

60 Cycles

Perth	3,478
Smith's Falls	6,021
Total	9,499

THE aim of the Bulletin is to provide municipalities with a source of information regarding the activities of the Commission; to provide a medium through which matters of common interest may be discussed, and to promote a spirit of co-operation between Hydro Municipalities.